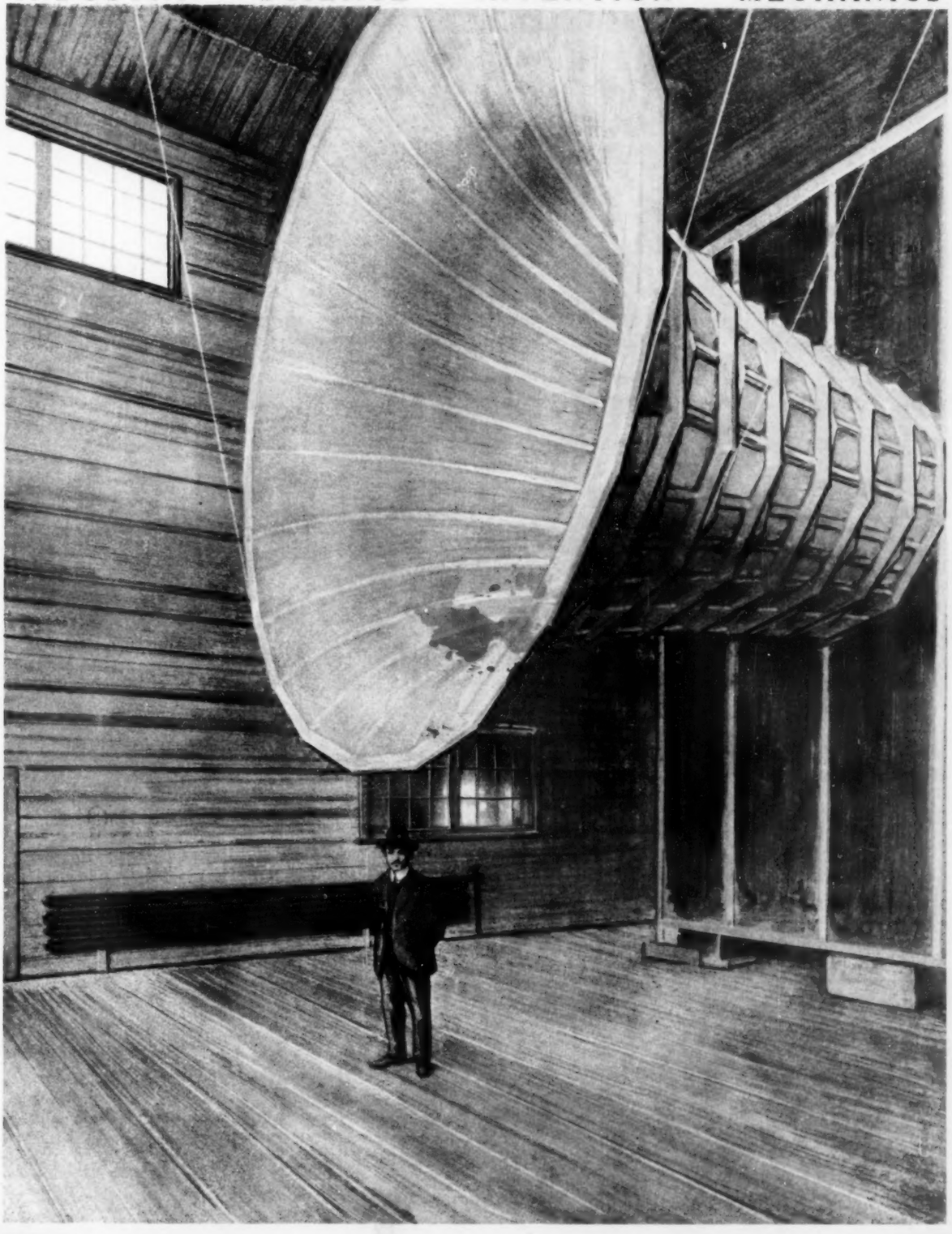
SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



MOUTH OF A SEVEN-FOOT WIND TUNNEL FOR TESTING AIRPLANE MODELS [See page 558]

Vol. CXXI. No. 23
December 6, 1919

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a year

Entered as second class matter June 18, 1879, at the post office a New York, N. Y., under the Act of March 3, 1879

Why Pay for a Truck Three Times?

1 ***The Purchase Price.***

The initial cost of an ordinary truck is but one item in the price you pay. Inferior quality must be paid for time and again after the truck is put into operation. WHITE quality costs money to produce, but saves money in the long run. Its cost comes but once in the life of a truck.

2 ***The Operating and Maintenance Expense.***

A constant charge against the truck's earning power. The poorer the truck the more it costs for fuel, oil, renewals and repairs. White Trucks operate with the utmost economy. They are known money savers.

3 ***The Cost of Idleness.***

The largest item of all. Loss of earning power for a day makes a serious inroad on profits; a three-day lay-up may easily equal a month's operating cost. That is the *direct* loss. The *indirect* loss, due to halted and delayed operations, may be far more serious.

IN White Trucks the purchase price is your total investment. The *operating* item is absorbed in high earning power. The *loss* item is little or nothing. White Trucks have the staying power to keep going. They do the ***most*** work for the ***least*** money.

THE WHITE COMPANY

CLEVELAND

Camel Cigarettes

Camels certainly do answer your keenest cigarette desires—

for quality, for refreshing flavor and fragrance, for smooth, delightful mellow-mildness, for "body" and for real and true satisfaction!

18 cents a package

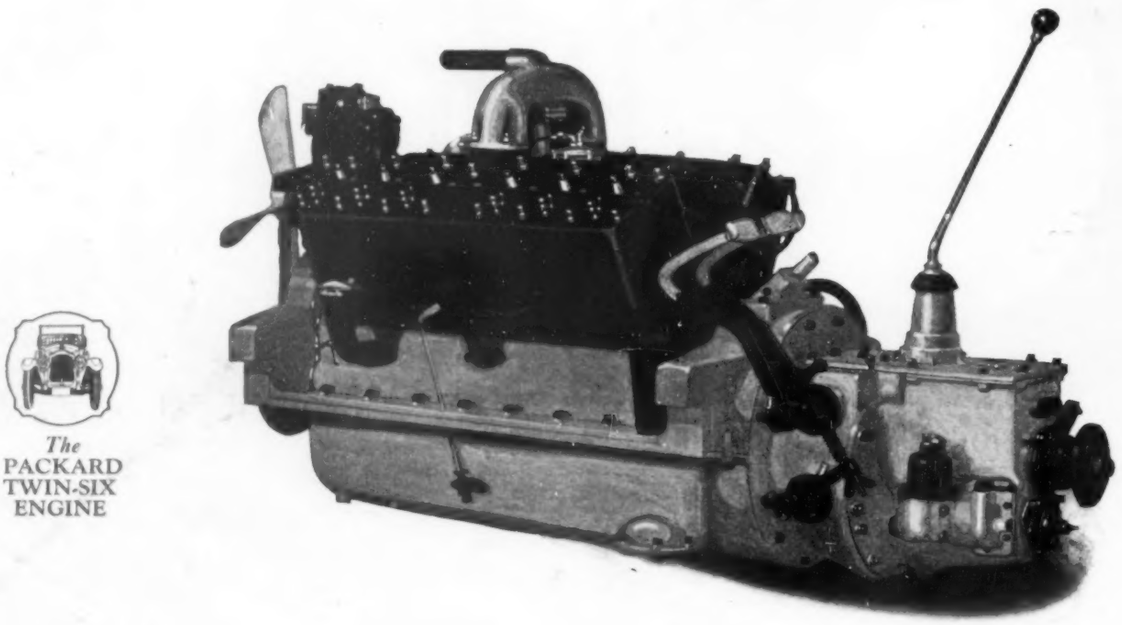
Camels are sold everywhere in scientifically sealed packages of 20 cigarettes; or ten packages (200 cigarettes) in glassine - paper - covered carton. We strongly recommend this carton for the home or office supply or when you travel.

R. J. REYNOLDS TOBACCO CO.
Winston-Salem, N. C.

You have only to get acquainted with Camels to realize the absolute superiority of the Camel blend of choice Turkish and choice Domestic tobaccos. And, how you will prefer the Camel blend to either kind of tobacco smoked straight! *We tell you it is a revelation!* Camels are so unusual, so unlike any cigarette you ever puffed on!

No matter how liberally you smoke Camels they will not tire your taste! And, it will delight you to discover personally that Camels leave no unpleasant cigaretty aftertaste or unpleasant cigaretty odor!

Compare Camels with any cigarette in the world at any price! You'll forget all about coupons, premiums or gifts!



The PACKARD TWIN-SIX ENGINE

PRODUCTION *of* PACKARD TWIN-SIX *to be Doubled* NEXT YEAR

ON September 2nd, 1919, the *twenty-four thousandth* Packard Twin-Six Motor Car was delivered to its owner.

It is worth noting that the engine in this twenty-four thousandth Twin-Six was *practically identical* with the original Twin-Six Engine introduced to the motoring world in June, 1915.

No experienced motorist will miss the importance of this fact—especially when he knows that in doubling our production for 1920 we shall still make *no major change* in the engine.

A basic engineering principle such as the Twin-Six embodies is not come at by chance—nor easily "improved."

The war aviation emergency, the greatest stimulus to motor engineering the world has ever known, confirmed definitely the 12-cylinder "V" type (Twin-Six) motor as a success because never before had flexibility, power and lack of vibration been combined to such a high degree in a single unit.

Most people are used to seeing cars change year after year—reflecting the faults found by owners on the road—or for the sake of "talking" points—or indicating a desire to make the owner buy a new car every season.

Established standards like the Twin-Six motor are certainly necessary—but none too plenty in the automobile business today.

❦ ❦ ❦

To the man with a motor problem we have this to say—especially if he has been looking for a motor car which cannot be *wished* out-of-date over night.

The Packard Twin-Six principle is *Established*—a permanent contribution to the Passenger Transportation service of the world.

❦ ❦ ❦

With your experience with the best of other cars fresh in mind—a single drive in the Packard Twin-Six will show you by direct comparison a new standard for acceleration, smoothness, speed, comfort, safety.

"Ask the Man Who Owns One"

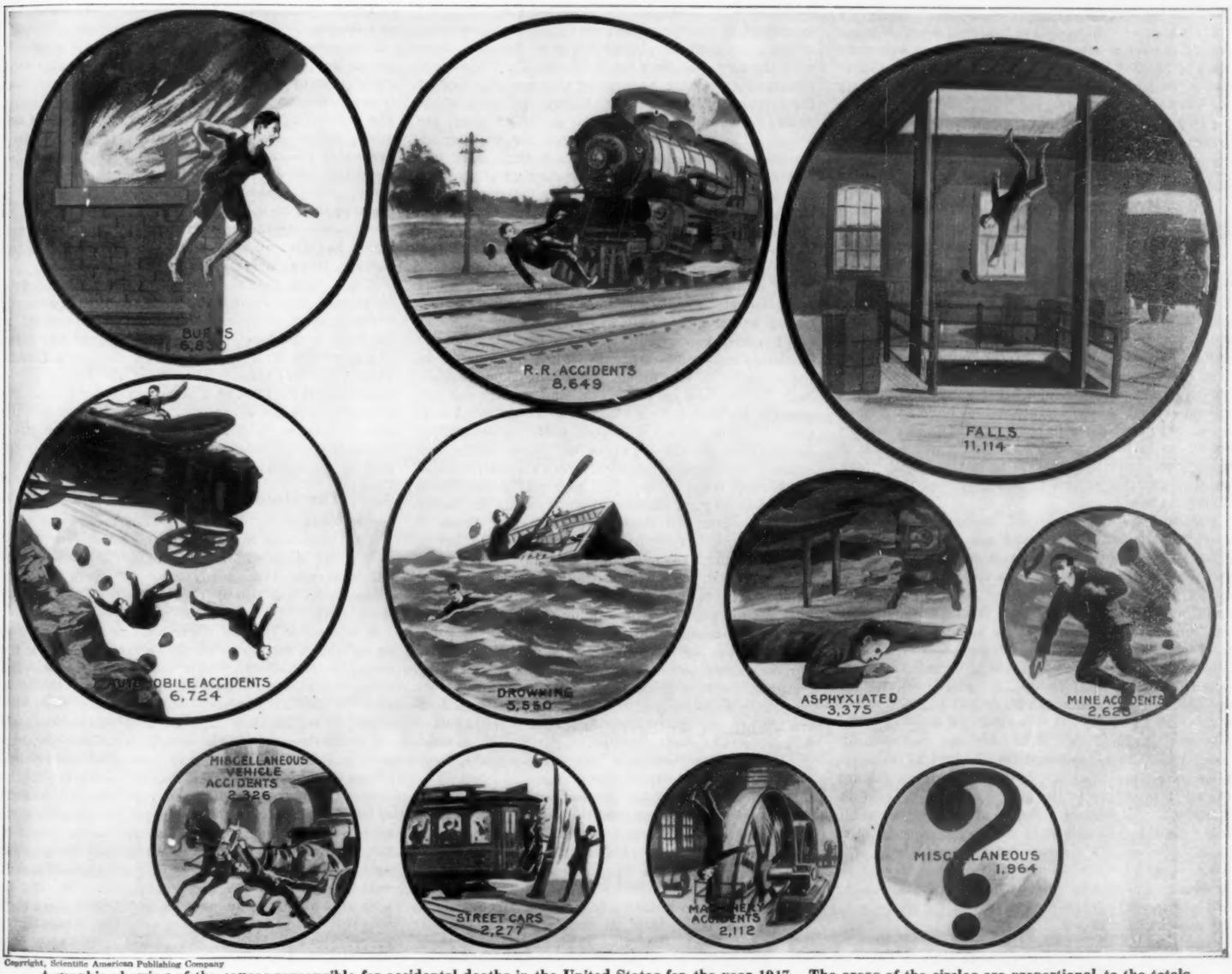
PACKARD MOTOR CAR COMPANY - - *Detroit*

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXI. NUMBER 23] NEW YORK, DECEMBER 6, 1919 [10 CENTS A COPY $5.00 A YEAR



Copyright, Scientific American Publishing Company

A graphic showing of the causes responsible for accidental deaths in the United States for the year 1917. The areas of the circles are proportional to the totals which they represent, and which appear inside them

How We Get Ourselves Killed

CARELESS America is growing less careless. This seems to be the conclusion justified by the mortality statistics for 1917, which have just been given out by the Census Bureau. The fact appears to be that as a result of the accident-prevention movement, the total of accidental deaths in the registration area of the United States—embracing about 70 per cent of our territory—some 6,500 less of us exposed ourselves to fatal hazards in 1917 than in the year before. The total of accidental deaths for 1917 was 53,544, as against 60,072 for 1916.

Our drawing depicts the distribution by causes of these 53,544 deaths. It shows that for the year in question more of us fell to death than met any other type of fatal accident. This is characteristic; the rate of fatal falls always leads the list, and varies but slightly from year to year. After it comes the railroad accident, with a rate greater than for 1914, 1915, or 1916, but less than for any previous year since 1906.

The caption "burns" excludes those received in railroad, street-car or automobile accidents, since these are more properly tabulated under the primary cause. This of course makes the caption "burns" reflect much more closely the carelessness of the individual than it otherwise would, and in fact it probably leads the list in this respect; among all accident victims, the probability that a man who gets burned is a direct sufferer from his own gross carelessness is greater than the corresponding probability anywhere else. A fire is such an obvious hazard, and one so easily avoided—even when it is a fire that starts in the furnace or the kitchen range and spreads to include the entire house. The rate for automobile accidents rises rapidly from year to year, because of the ever-increasing number of cars in use; but it does not keep pace with the latter figure by any means, so we must conclude that the automobiling population is getting a little more careful, and perhaps that those of us who go afoot are becoming educated as to the rights which we

(Continued on page 564)

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.

Founded 1845

New York, Saturday, December 6, 1919

Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Copyright 1919 by Scientific American Publishing Co.
Great Britain rights reserved
Illustrated articles must not be reproduced without permission

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Hysteria Among the Admirals

WHAT else can we call it but hysteria when Admiral Sir Percy Scott says: "The battleship is dead. . . . Battleships were dead before the war, and I think they are more dead now. . . . The battleship waddles along at twenty miles an hour and cannot waddle far. . . . When a battleship nears the end of her coal and ammunition supply she must waddle home, and it takes several hours to refuel her, even if she uses oil. An airplane will return at one hundred miles an hour, and takes only three minutes to load again." And if it were anyone but Lord Fisher, we should put it down to hysteria that he has written six letters to the *London Times*, and a whole book, to prove that pretty well everything in the British Navy, whether afloat or ashore, is wrong—except the gallant Admiral himself.

But we are not concerned so much with Lord Fisher's diatribes. Those who are interested in the brilliant, eccentric, over-masterful and choleric old sea dog can find much interesting naval gossip in surely the spiciest book ever written by an admiral, British or otherwise. Iago said he was "nothing if not original," and Fisher is nothing if not explosive. As to the good taste of his wholesale denunciation of his brother officers in the same breath in which, by indirection, he extols his own infallible genius, there will be but one opinion, both inside the Navy and out.

Admiral Scott says that battleships were dead before the war, and he thinks they are "more dead" now. It will be remembered that in 1914 he made the same statement. Six years have passed since then, and five of them witnessed the greatest series of naval operations of all history. So far from the battleship being dead, in our opinion it was never so much alive as it is today. It was the silent stranglehold of a navy whose strength, in the last analysis, lay in its fighting line of dreadnought battleships, which was one of the principal contributing causes of the overwhelming defeat of the enemy.

Admiral Scott thinks that the battleship has already given way to the airplane. "It takes a battleship," he says, "weighing 30,000 tons to carry 100,000 pounds of high explosives. Ten airplanes of three tons each could carry the same amount." But so far from the airplane having destroyed the value of the battleship, it is a fact that in all of those five years of war, not once was a battleship destroyed by an airplane, and not once did an airplane even hit a battleship that was under way.

As a matter of fact, the evidence in the case points all in the other direction. That is, it shows how completely ineffective is airplane attack in sinking or seriously disabling the battleship. Proof of this was seen at the Dardanelles, when the airplane had the chance of its life in attacking the heavily armored battle-cruiser "Goeben." The conditions were ideal for the airplane, and the worst possible for the cruiser, for the "Goeben," in entering the Dardanelles had run aground, and therefore could not maneuver. So, the flying men had everything pretty much their own way, and theoretically they should have bombed the "Goeben" to pieces. As a matter of fact, the ship was subsequently floated and returned through the Straits to Constantinople at fifteen knots, under her own steam.

The case for the airplane or the airship as a substitute for the battleship would be fairly strong, and the statement of Admiral Scott would be less preposterous, if the aiming of bombs from an airship had anything of the accuracy of the projectiles thrown from the heavy guns of a battleship. But so far as accuracy in hitting an object the size of a battleship is concerned, the airplane bomb is about the most inaccurate of all the missiles that are known to the modern art of ballistics. As an airman once said: "It is really astonishing how much you can miss from an airplane." In regard to its inaccuracy, or rather the inaccuracy of the aiming, the airplane bomb is in the same class with the torpedo. Both the bomb and the torpedo are remarkably accurate weapons if they are launched at the proper angle with relation both to the speed of the firing craft and of the target at which they are aimed. The public may be excused for drawing inferences from the ease with which a huge mark like a city can be bombed, overlooking the difficulty of hitting a definite mark like a particular building on land or a particular ship at sea, from the height of 15,000 to 20,000 feet to which the attacking aircraft are forced by the accuracy and volume of anti-aircraft fire.

The battleship may "waddle" to use the Admiral's poetic term, and it is true that on exhausting its fuel and ammunition supply it must return to port at but twenty knots' speed, while the airplane can return at one hundred knots. But he omits to state that the battleship can waddle from five to ten times as far as the airplane on one filling of its tanks and bunkers. No. We can see no reason to suppose that the airplane is destined to be a cheap "kill-all" in naval warfare any more than the torpedo boat, the submarine, the so-called dynamite gun, or any other of the sensational inventions which have shown themselves above the horizon down through the past fifty years. Each of these in its turn has settled down to take its proper part in the great, diversified and complicated scheme of naval warfare. The airplane will supplement but it will not suppress the battleship. Already it has proved its value as an aid to the battleship in the two most important fields of scouting and spotting. The British have got the right idea in building their Argus mother ships, big, broad-platformed vessels, capable of going anywhere, nesting from twenty to thirty airplanes below deck and able to send them out hundreds of miles ahead of the fleet to get early tidings of the enemy's location, disposition and strength. As an aid to modern gunnery in spotting the fall of shot the airplane will prove to be simply invaluable, particularly in these days of sixteen-inch and eighteen-inch guns, with ranges of from twenty to thirty miles.

So far from rendering the battleship obsolete, the airplane, because of its superb scouting and spotting possibilities, has prolonged the era of the battleship and rendered it even more efficient than before.

Art and Science

WHEN two terms are found constantly associated together, it is reasonable presumption that there is some kind of kinship between them. We have sundry academies, institutes and departments of Arts and Science. Yet, in the estimation of some, art and science are well-nigh diametrically opposed in their aims, interests and relation to human feelings and doings.

The artist, the typical artist of popular conception, is something of an impractical dreamer. He wears long hair and a shabby coat, and, though himself far from pleasing in appearance, he is concerned with the ornamental, not the useful aspects of life. He is regarded with patronizing toleration or with something approaching veneration, according to the temperament of the person regarding him.

The scientific man is a more recent arrival upon the stage of affairs, and is, accordingly, less well known, perhaps less well understood than the artist. He may be thought of either as a rank utilitarian, a man who dabbles in all sorts of unsavory messes; to whom garbage is dear as a potential source of value; to whom the azure sky suggests nothing more significant than tons upon tons of nitrogenous fertilizer (as he expresses himself in his intolerable jargon); in whom the surging billows of the mighty ocean inspire no emotion more noble than the greed of gold—for he has discovered that untold wealth is dissolved in those waters.

Or, if he belongs to another type, he may be even more impractical than the artist, for he spends his time finding out all sorts of things that nobody ever wants to know; things that, having no apparent utility, cannot even boast of the redeeming virtue of adding to the beauty of creation.

Such, if we may be permitted a certain poetic license to caricature, are some of the current conceptions, or rather misconceptions regarding the devotees of art and science.

Now as for facts. The painter, unless he is willing to return to primitive standards long outgrown, must make constant use of his knowledge of perspective, that is to say, of geometry, a branch of mathematical science. The pianist, when he bows to the applause of an admiring audience, should, by rights, give at least some portion of the credit to those who have brought that wonderful piece of mechanism, the modern concert piano, to its present perfection. And if he is very broad-minded, he may even be willing to admit that he owes something—however trifling—to the phonograph which has aroused interest in classical music where, perhaps, it was never heard before.

If you think that the modern architect has no debt to science and technology, look at the Woolworth Building, that Cathedral of Commerce, monument to the spirit of the New World, when next your way takes you past City Hall Square or over Brooklyn Bridge. Feast your eyes upon the beauty of its silhouette outlined against the blue, on a fine morning, or against the mingled colors of a sunset sky. And remember that the structure rears its head with the strength of steel: modestly hidden beneath the work of the artist is the skill of the engineer.

The History of a Great Invention

VERY characteristic of the development of many successful inventions is the story recently told by Admiral Jellicoe of the incident out of which sprang the greatly dreaded depth bomb—a weapon that was mainly responsible for the defeat of the U-boat.

It seems that early in the war a fast British cruiser, on sighting a submarine on the surface, dashed for the enemy at full speed in an attempt to ram her. The submarine submerged just in time to escape the blow, and the officers and crew of the cruiser were chagrined to realize that, although they could clearly see the submarine below them as they swept over her, they were unable to do anything to damage or destroy her.

One of the officers of the ship, on narrating the incident exclaimed: "If I had only possessed some form of bomb which I could have dropped on the enemy, we could have destroyed her." This led to the construction of various devices, one of which was the so-called submarine dart, consisting of a high explosive shell with a shaft attached for throwing it. The trouble with this and any similar form of direct-contact shell was that it was only once in a very long while that a charging cruiser or destroyer passed immediately over the submerged enemy ship. When she made her rush she got near, of course, but seldom near enough for a direct hit with a shell or bomb.

The next step, then, was to aim at the destruction of the submarine by means of a heavy concussion, transmitted through the incompressible water from a bomb detonated below the surface and in the vicinity of the submarine. Then followed the cylindrical-shaped bomb with its fuse set to function by hydrostatic pressure at any desired depth. From sixty pounds' weight, it rapidly rose to two hundred, three hundred, and, at the close of the war, the charge was six hundred pounds, this last a bomb that would destroy any submarine within a hundred and seventy feet of it and was almost certain to disable one at three hundred yards.

Naval and Military

Navy Pay.—The *Army and Navy Journal*, speaking of the need for more Navy pay, says that the question involves the self-respect of the United States, richest and most powerful of nations. The country should not be discounted in the sight of the world, through a comparison of the crumbs the Naval Committee would throw to the Service with the liberality of the British increases, that range as high as one hundred per cent, and of the French and the Italian increases, approximating those of Great Britain.

Raking for Submarines.—It is not generally known that in the early work of developing the paravane, there was developed a form of submarine rake which acted on the principle of the hay rake. Two charges were towed directly over the stern of the ship at an angle of forty-five degrees, and two other charges were towed on each beam of the vessel and kept in place by what was termed a surface torpedo. Then followed the explosive paravane, and finally the type, as described in this journal, which was towed from the stemhead of the ship.

Sandy Hook Proving Ground Discontinued.—It has been decided that the establishment of the very fine proving ground at Aberdeen, Maryland, has rendered the use of the Sandy Hook Proving Ground superfluous, and it is, therefore, to be discontinued. Certain shops are to be turned over to the engineers of the New York Engineer District, and other buildings and facilities will be handed over to the Coast Defense Commander at Fort Hancock. Sandy Hook will be used in the future, but only as a vocational school for training enlisted men and junior officers in artillery work.

Destroyer Built in 45½ Days.—The construction of a 1,200-ton, 35-knot destroyer in 45½ days is something which calls for congratulations to the yards at Squantum, near Boston. The keel of the "Reid" was laid September 9th. She was launched October 15th, and on October 31st, after undergoing a test by the Government Trial Board, was accepted. The "Reid" is driven by turbines of 30,000 horse-power at a speed of 35 knots. She is named after Captain Samuel Chester Reid, a naval officer who won distinction in the war of 1812 when in Fayal Harbor he won a fight against absurd odds.

Germany Built Over Eight Hundred Submarines.—Vice Admiral Von Capelle, former Minister of the Navy, recently told the Assembly Committee that 810 submarines were built by Germany before and during the war. Of these, 45 were built before the war, 186 during the administration of Von Tirpitz, and 579 were built under the Capelle administration of 2½ years. Asked what was the exact purpose of the submarine campaign against England, the Admiral said that he had believed that by unrestricted use of these craft he could force England to a "usable peace" within five months' time.

Our Fine Artillery Equipment.—Major General C. C. Williams, Chief of Ordnance, says in his annual report that the Ordnance shops and depots of the War Department are adequate to meet any demands. The Department now possesses fourteen manufacturing arsenals equipped to 100 per cent capacity, and a sufficient reserve of dies and tools to outfit a score of additional plants. Compare this with conditions three years ago, when a secret board reported to the Secretary of War that at least eighteen months from the beginning of operations must elapse before vital munitions could be produced.

Length of Liners and Warships.—The stay of the battle-cruiser "Renown" in our waters has raised a discussion as to which are the longest ships afloat. Of course, among merchant ships, the "Leviathan," 950 feet long, is the longest, with the "Imperator" and the "Aquitania," each 900 feet long, of the Cunard line, coming next. Among warships, the longest in commission today are the "Renown," and her sister, the "Repulse," each being 789 feet. But the longest warship constructed and soon to go into commission, is the British battle-cruiser "Hood," which is 900 feet in length and about 42,000 tons full load displacement. Our Navy Department has designed six battle-cruisers 875 feet in length.

Science

World's Record for a Brief Shower.—According to a recent article by H. G. Cornthwaite on the rainfall of Panama, a downpour of unrivaled intensity occurred at Porto Bello on May 1, 1908, when a fall of 2.48 inches (63 millimeters) in five minutes was recorded by a self-registering rain-gage. This fall, at an average rate of 12.6 millimeters per minute, is believed to constitute a world record, its nearest rival being a shower at Curtea-de-Arges, Roumania, on July 7, 1889, when rain fell for 20 minutes at an average rate of 10.2 millimeters per minute.

A Dangerous Disease of Sugar Cane.—The Department of Agriculture has issued a warning on the subject of the mosaic disease of sugar cane, the presence of which has recently been discovered in Louisiana and other southern states. The Department has made a thorough survey of the infected area and investigated methods of controlling the disease. Sugar-cane growers are urged to use great care in the selection of seed-cane, as cuttings from diseased stalks invariably produce diseased plants. The general appearance of the diseased plants suggests the mottled leaves characteristic of tobacco mosaic. In order to aid growers in identifying the disease, the Department is preparing an illustrated booklet with a series of colored illustrations. The pamphlet will also tell in detail how to check the disease.

Mysterious Luminous Phenomenon at Sea.—A note on the back of the British Meteorological Office's *Monthly Meteorological Chart of East Indian Seas* for October, 1919, records a curious phosphorescent phenomenon observed by the steamship "Clan Ogilvy" when nearing Madras July 3, 1919. At 2:10 a. m. streaks of luminosity were seen on the water in the form of a gigantic wheel, with many curved spokes turning the same way as the hands of a clock. The phenomenon lasted for ten minutes. The "spokes" were about four feet broad at the ship, and they passed at the rate of about 12 every 10 seconds. The wheel was traveling to eastward. As each "spoke" passed the ship was lit up so brightly that the captain came on deck and asked what vessel the watch officer was "Morsing" to. Similar phenomena have been reported before from the East Indian seas, but no satisfactory explanation has yet been offered. An illustrated article on this subject was published in the SCIENTIFIC AMERICAN of June 13, 1912, p. 51.

Recurrent Irregularities of Temperature.—A popular belief has prevailed for ages in many parts of the world that certain unseasonable conditions of temperature tend to occur from year to year at about the same dates. In America we hear of the "January thaw," "squaw winter," "Indian summer," etc., while in Europe the best known of these supposedly constant features of the climate is the cold period of the "Ice Saints" (May 11-14). The European equivalent of our Indian summer rejoices in numerous names (St. Martin's summer, old wives' summer, after-summer, etc.), and the dates assigned by tradition to its occurrence vary from country to country. Whether these alleged interruptions in the regular progression of the seasons are genuine phenomena is one of the mooted questions of meteorology. It is of especial scientific importance in connection with the problem of computing daily temperature "normals" from the data of observation available for stations having long meteorological records. Prof. C. F. Marvin, Chief of the Weather Bureau, has recently published a memoir on this subject, in which, as the result of a mathematical discussion of numerous American weather records, he reaches the conclusion that "the annual march of temperature is a smooth curve devoid of secondary maxima and minima or of perceptible points of inflection," and that "marked irregularities, such as connoted by terms like the January Thaw, the May Freeze, etc., do not persist nor have a real existence. When such irregularities still remain in the means of a long record they are simply residual imprints of a single or a few fortuitously recurrent extreme or unusual events." As a pendent to Prof. Marvin's discussion, Prof. C. F. Talman presents a comprehensive annotated bibliography and a digest of the literature, extending from the year 1820 down to the present time.

Industrial Efficiency

Chinese Coal for United States.—What is said to be the first shipment of Chinese coal to the American Continent was made in June, when 1,600 tons were shipped from Chinwangtao to Alaska. The price of the coal was reported to be $7.00 per ton, f.o.b. Chinwangtao, and was bought by a canning plant at Bristol Bay.

Use of Slate Waste.—In connection with the production of roofing slate at Bethesda, Wales, an enterprise is being developed for the manufacture and production of fine inert powders from 20 mesh up to 200 mesh for use in the manufacture of asphalt, bricks, cement, glass, linoleum, tiles, mantels, paints, insulators, and other articles where weather-resisting and good-wearing qualities are desired. This powder is produced from slate waste to be found around all North Wales slate quarries in large quantities.

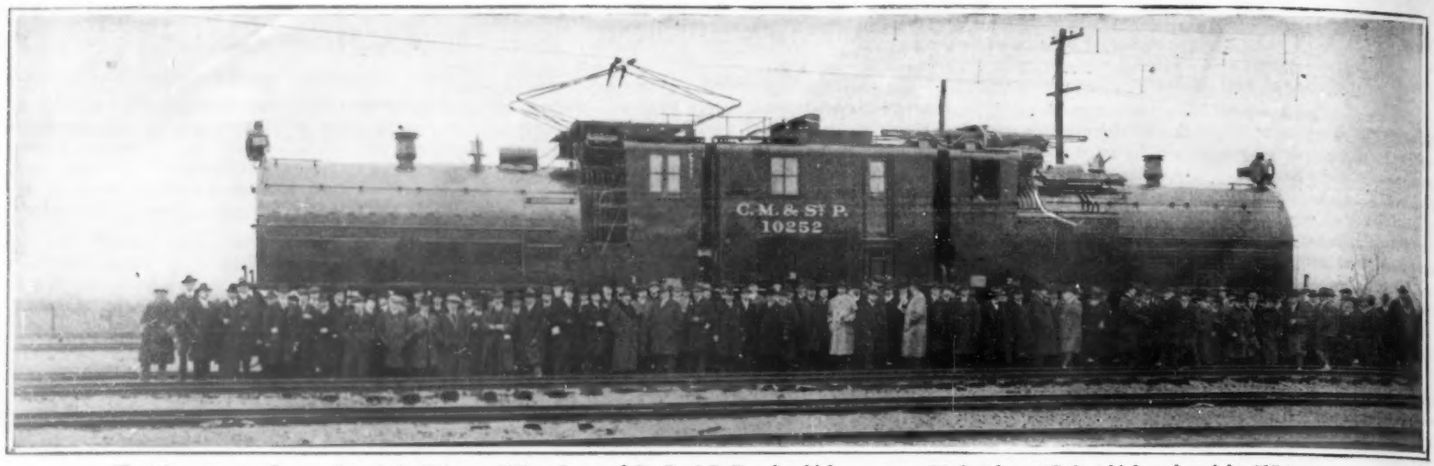
Accident Prevention.—If we are to get results that will be self-sustaining and permanent, they must not come about from bare instructions from superiors, but we must educate the individual to do these things—not as something in addition to his regular routine work, not as something separate and apart from himself or the gang, but as a part of his every thought, his every movement. He must realize that the safe way to work is the right way to work, continues the *N. S. C. Bulletin*, and a routine that carries with it, through hurry or bad practice, any chance of accident from any cause whatever is the wrong way to work.

Machinery Situation in France and Belgium.—After eight months spent in studying the industrial machinery situation in France and Belgium, Trade Commissioner Charles P. Wood, of the Bureau of Foreign and Domestic Commerce, has returned to this country and is visiting various manufacturing and industrial centers to discuss with business men the facts his investigation has brought to light. How to take advantage of opportunities in France and Belgium, on terms profitable to all concerned, and in the face of the present adverse exchange situation, is a problem now perplexing American machinery manufacturers as well as their bankers and financial associates.

British Imitation Hat Velour.—American visitors to England—especially women—have remarked upon the high prices of British millinery. Hats in the United Kingdom are very much higher priced than in the United States. This season the velour hat is again very popular, but, as velours are rather expensive, they are beyond the reach of women with little money to spend on dress. To meet this condi tion an English hat manufacturer is placing on the market an imitation velour made of stiffened cotton flannelette. The material for the manufacture of this particular style of hat is being turned out by a large textile firm in Manchester in great quantities.

Hard-Wearing Cloth.—A new textile fabric which, it is claimed, will tend to lower the present high cost of men's clothing is being placed on the market by a Pudsley (Yorkshire) manufacturer. The London agents of the manufacturer state that the new cloth is made entirely of silk noil (or short fibers), and that, while superior in wearing properties to a pure worsted, it can be sold at the price of shoddy cloth, or one-fourth the price of the best wool fabrics. It is said to be strong and almost untearable, very suitable for hard wear, and can be obtained in grays, browns and blacks. The new fabric is claimed to be a British discovery and is at present manufactured only by one firm.

Salt Produced in Holland.—Several reports have been made regarding the formation of a company to bore for salt in the Provinces of Gelderland and Overyssel, Holland. Some weeks ago it was announced that the boring had struck salt. Now it is stated that the first salt has been delivered, consisting of three carloads. The preliminary expert investigation indicated the possibility of a billion tons or more of salt underlying the soil of those provinces. If the quality is satisfactory (of which nothing has yet been said) and production is fast enough, Holland will be independent in regard to salt. Its consumption of salt is about 170,000 tons a year, all of which has hitherto been imported.



Electric passenger locomotive of the Chicago, Milwaukee and St. Paul Railroad, which measures 78 feet long, 17 feet high and weighs 265 tons

Electric vs. Steam—A Tug of War

An Interesting Test of the Giant Electric Locomotive Built for a Western Railroad

WHEN 150 prominent railway men and engineers from many parts of the United States and Canada, gathered at Erie, Pa., a few days ago to witness trial tests of a new type of gearless electric passenger locomotive, they believed, most of them at any rate, that the exhibition would be of a quite perfunctory nature. Instead, they saw what F. J. Sprague, noted consulting engineer and known as "the father of railway electrification," described as "the most magnificent exhibition of electricity applied to railroads, that the country has ever seen." "Indeed," added Mr. Sprague, during a dinner which followed, "I think the thing has never been duplicated in this, or any other country."

The feature of the exhibit, sprung at the last moment, was probably unique in the annals of electrification, for it was a test of brute strength between two powerful steam locomotives and the new electric—nothing less than a tug of war between three monsters of iron and steel to a stand-up finish.

Throughout the greater part of a dark, cold day, in the works of the General Electric Company in that city, these engineers and railway men had been busily engaged in comparing notes and figures and examining with interest the great electrical monsters. Nearly a dozen high-speed tests had been run off over the company's test tracks, in which one of the new locomotives without gears or transmission, hauled two passenger trains filled with guests over the four miles of track, at a speed of more than a mile a minute and carrying twenty passengers in the cab on each run, while a battery of camera men reeled off some highly interesting pictures.

The stellar event of the day's activities which had been crammed full of action from the beginning, took place just before dusk. Two modern steam engines—the kind the New York Central uses to haul its big limited trains—were switched to the spur of track and coupled securely to the electric locomotive. If the two contestants had hauled in opposite directions there might have been danger of pulling out the draw bars and a resultant accident. This possibility was avoided by having them push against each other in different directions.

At a given signal from the supervisor of tests, the steam engines got under way and began shoving the big electric ahead of them along a short piece of straight-way track; then the current was gradually turned on the electric while the engineers of both steam locomotives opened up their throttles to the last notch.

What was the surprise of the crowd to see the steam engines slowly but surely lose momentum and finally come to a complete stop still with their throttles wide, puffing and chugging as under an extraordinary strain. Then what appeared to be the impossible happened and a great cheer went up from the crowd as they saw the steam engines forced backward, first only by inches, but gradually as the full power of the electric was brought into play, the procession became almost a rout and when the test ended a few minutes later the steam locomotives were moving steadily backward and the electric locomotive was declared the victor.

Interesting and spectacular as this test must have been to the laymen present, it was more significant to the engineers of the General Electric Company who had devoted years of their life to the perfection of this powerful electric locomotive. It was a conclusive test of power between steam and electricity.

Hardly second in interest to the tug of war, was an exhibition of the regenerative powers of the electric locomotive, which preceded it. The locomotive which is one of five being constructed for operation on a new electrified branch of the Chicago, Milwaukee & St. Paul R. R., hauls over a mountainous district and must frequently coast down steep grades. While doing so the engineers have so designed the engine that the locomotive will, by the turn of a switch, turn its power plant into a generating station and send back quantities of "juice" to the power station. In other words the electric motors are converted into electric generators. This process of regeneration acts as a brake to the progress of the engine down a hill, while at the same time it stores up new current which will later be called upon to propel the locomotive on the level or up the next grade.

The strength of the regeneration braking was given a spectacular exhibition. To reproduce the same conditions as those which exist when the engine is coasting with a full load of cars behind, two steam locomotives were coupled on behind the electric and pushed it along the track at a good speed. The regenerating system was then switched on and the steam locomotives soon found they were bucking a hard proposition. To overcome the regenerative braking power of the electric the steam engines were very quickly puffing like a stout man running for a train. Soon the speed was seen to noticeably decrease and before the trial was completed the two big steam locos had pretty much all they could do to make headway under full steam. All of this time the electric was turning back current to the power house, the dials of which indicated this to a group of expectant engineers who had gone inside to watch them with growing interest.

This new locomotive is one of the most powerful passenger locomotives in the world. It uses 3,000 volts direct current and its horsepower is 3,240. There are fourteen axles on which are mounted direct-connected motors. The locomotive is 78 feet long, 17 feet high and weighs 265 tons, of which weight 229 tons rest on the drivers. The locomotives have been designed for handling in normal service a 12-car train weighing 960 tons trailing against a grade of 2 per cent at 25 miles per hour. Tests have shown that the gearless electric locomotive operates at 10 per cent higher efficiency at 50 miles per hour than the geared type.

The center cab is occupied by an oil-fired steam boiler for heating the passenger trains, with accessories including tanks for oil and water circulating pumps and a motor-driven blower for furnishing forced air draft.

The contest between the great electric locomotive and two steam locomotives

Determining the Purity of Gases

AT a recent meeting of a scientific body in London, there were exhibited several instruments embodying the principle of Dr. G. A. Shakespear's katharoneter for determining the purity of gases. The principle upon which this is based is as follows: Two small platinum coils are placed in two cells, each about one centimeter in depth and half a centimeter in diameter. One of these contains the gas to be tested, *e. g.* the moist air in a workshop, while the other contains the standard air, *e. g.* dry air. These coils form two arms of a Wheatstone bridge, the resistances depending upon the degree of viscosity of the two gases respectively. The coils are heated in the humidity recorder by a battery of four volts; the humidity is automatically recorded; hygrometers have been found to be unreliable in the long run. In the hydrogen-purity meter the coil is heated to 800° C., and the cooling depends upon the density of the gas, since all possible impurities are denser than the hydrogen itself. The permeameter, the third instrument of this type, is used for testing air-craft fabrics. A disk of the fabric to be tested one foot in diameter (500 sq. cm. in area) is placed on the permeameter, which is a horizontal disk of gun metal having concentric grooves; the space above the fabric is filled with hydrogen, which can escape only through an opening in the center of the permeameter; this opening is closed by wire gauze, and through it the escaping gas passes into the cell block of the type mentioned above. The presence of local leaks is likewise disclosed by this apparatus.

These ingenious arrangements are described in a recent issue of *Engineering* of London, to which we are indebted for all of the foregoing details. These devices should have a wide application in aircraft works, especially balloon works.

Houses by the Bucketful

Latest Developments in the Construction of Identical Dwellings of Concrete in a Single Piece

By Floyd Hamilton Hazard

IT is quite customary that some guest be invited to pour the tea at an afternoon tea party. But suppose you were invited to a house party and asked to pour your own house? This is a rather startling idea but, with reservations, it is a perfectly practicable one.

Public attention is so focused on securing adequate housing facilities that we may with profit consider recent developments in monolithic concrete house construction on a wholesale basis. An opportunity to do this is presented in the fourteen four-room, two-story houses of this type now completed at Union, N. J., and the twenty-five four-room and fifty six-room, two-story houses now being built at Phillipsburgh, N. J. These practical developments of Thomas A. Edison's original idea of pouring an entire concrete house in one piece, depend upon the application to house building of the principles of cycles of production. The house shells are monoliths of reinforced concrete, with outside walls, interior partitions, roof and floor beams, flat arches spanning between beams, chimneys, cornices and parapets. The basic idea is that of die casting.

Sectional, standardized, heavily built-up wooden forms are so made that they form a mold, as though a pattern house had been molded inside them and then withdrawn. They are painted with gray lead and oiled before use. This mold is then filled with molten concrete, instead of the molten metal used in metal casting. The forms are then removed and set up for the next house.

Thus, these houses can be reproduced again and again, in every detail, from the same forms. Workmen are so trained to perform each individual operation that all unnecessary work is eliminated and by a continued repetition of certain unit operations small, livable houses, sanitary and permanent, are produced in quantities at the lowest possible cost.

Each form section has its allotted place and bears a simple code number. Specially trained laborers can thus perform the entire operation of erecting. Allowing for delays, one set of forms can be used for forty houses per year. As the greatest economy results from reproducing one design to a maximum and thus reducing the cost of the forms per house, this plan is not practicable for a single house. But as few as ten four-room or fifteen six-room houses can be economically built. A complete four-room house requires about 1,000 pounds of steel reinforcing and 65 cubic yards of concrete. The concrete is one part cement, four parts clean sharp sand free from loam and four parts clean hard coal cinders.

The four-room houses in both developments are 16 feet by 24 feet in plan, with entry way or hall, front and rear, into a living room and a kitchen. They have a center stairway, two bedrooms, two closets and a bathroom on the second floor. At Phillipsburgh the six-room houses are 20 feet by 24½ feet in plan, with entry into the living room, corner stairs from thence and from the kitchen to the second floor, a front room and a rear porch with kitchen entrance; on the second floor are three bedrooms and a bathroom.

About three days are required to erect a set of forms. Nine men are utilized on four-room and eleven men on six-room houses. An entire house can be poured in eight hours. Because of the two extra men, a six-room house can be poured in the same time required for a four-room house. The forms begin to come down in 24 to 48 hours after the concrete has been placed. It is thus possible to pour one house per week.

The forms were removed from a completed house in Phillipsburgh on Monday, then moved across the street and erected. Another house was completely poured and the same forms were ready for removal on the following Saturday.

An excavation is first made and the footings and basement floor are poured in one piece. Then the house forms as a whole are placed. The entire weight of the forms and concrete is first placed on trussed, vertical, wooden corner posts. Above the basement floor the house is poured to its full height during one continuous operation. Pouring is done as rapidly as is possible; if it cannot be continuous it is stopped at the top of a floor level.

No top form for floors are required, because properly proportioned concrete forming a flowing mixture will continue to flow only so long as the motion is continuous. Pouring is therefore first on one side until the concrete reaches a floor level, then on the other side, then returning to the first position. Allowed a few minutes to congeal, no further flow of concrete out of the inside forms shaping the floor takes place.

Reinforcing, plumbing roughing, electric conduits, metal flue lining for chimneys, window frames, door bucks and furring strips are all placed inside the forms before the house is poured.

Copyright, International Film Service

One-piece concrete house that is built in ten days

For form removal the wedges are driven from under the vertical corner posts and these drop down; they are first required on the next house and so are first removed and set up there. The trusses are then supported by the bolts which pass through the walls. These now take the load first put upon the posts. The trusses are then removed and set up on the corner posts of the following house. Form parts then come down piece by piece as needed, the floor forms being the last because last needed on the following work.

Operations at Phillipsburgh were continued through the past winter. Houses were heated four days and forms were then removed safely. Straw was packed around exposed places to avoid hazard of freezing.

Costs are figured on cubeage, i. e., cost per cubic foot, and these houses are said to cost no more than frame houses of similar size. Considering quality of workmanship, durability and low upkeep, they may be said to cost less. The four-room houses were originally planned to cost $1,000, but this became impossible because of high labor and material costs. The average cost of twelve houses at Union was $1,963 in 1918; labor was $966 and material $997. This was an experimental operation where methods were being continually revised and a crew of new men being trained.

The cost curve on these concrete houses is now said to show a downward trend, due to improvements in methods, minute standardization and material purchases in quantities. It is stated that present costs closely approximate a figure of 25 cents per cubic foot.

The average person is prejudiced against concrete by fear of dampness, but to prevent dampness the inside walls are furred out to leave an air space between the plaster and the outside wall, a tar paint is used on inside walls on the concrete, before the inside finish is put on, and hydrated lime stucco is used to finish the exterior walls. The flat roof is made watertight by a coat of hot asphalt.

Inside walls have wood or metal lath and two coats of plaster. Floors, stairs, sash and doors are wooden. Concrete partitions are finished with one white plaster coat. The first floor ceiling has one white plaster coat direct upon the concrete; the second floor ceiling is furred and plastered as for the outside walls and has a white coat finish. All interior walls, partitions and trimmings are painted as desired.

The fixtures furnished are a lavatory, bathtub and water closet in the second floor bathroom. Provision is made for a kitchen range and hot water boiler, there being also cupboards and a kitchen sink.

The identical structure of these houses and their similarity of aspect is largely overcome by grouping them around courts, by setting houses at different angles, by connecting pairs of houses, by suitable planting of trees and shrubs, by pergolas and lattice work and having several different designs of entrance hoods.

A housing enterprise of several hundred dwellings might have several different sets of forms, producing as many different designs that could be interspersed, but an entire new set of forms must be developed for each separate size or type. It is claimed, however, that 50 to 100 houses would justify new forms.

These houses are vermin proof and can be kept thoroughly clean. They are durable and their maintenance cost is low. It is claimed that there is no limit to their size or form and it will be illuminative to follow the full development of all the possibilities of such construction.

THE housing problem stays by us, and it plainly will not be wholly solved for some years. The ingenious expedient is of course an answer only in individual cases and on a small scale; we cannot all live in abandoned street cars or reconstructed chicken houses. What is really needed is a process of house building which shall cost less in time, in labor, and in materials. One possible way out is the concrete house. Various have been the suggestions looking toward the greater use of this material in dwelling houses; the present article outlines a system that seems to possess more than its fair share of merit.—THE EDITOR.

Detection of Oil Sources Claimed by Electrical Means

LOCATING crude petroleum by means of an electrical device, no matter how far beneath the earth's surface the product may be, has been successfully done in the shallow field near Corsicana, Texas, during the last few weeks, according to reports given for what they may be worth by the *Electrical Review;* and Eugene Elkins, the inventor of the instrument, has gone to the outlying district around Burkburnett to make further practical tests of what is claimed to be a very remarkable invention. The oil industry may be revolutionized if oil pools can be located by means of so simple an instrument. The principle upon which it works is described by Mr. Elkins as follows:

"The system consists in forming an electrical circuit through the earth by dropping an insulated wire to the bottom of a dry water hole, valley or indentation and placing a series of batteries on top of the earth, to the positive pole of which is attached a land wire. This land wire is then taken out over the field in any direction and for any distance and all of the intermediate territory is combed thoroughly with electric currents flowing from the anode or positive pole to the cathode or negative pole. The earth being simply a huge inverted magnet, the electric currents travel from one to the other of the charged poles by the path of least resistance, much as does the return current of the telegraph system through its ground wires to the point of origin.

"Oil and its constituent components being the only minerals in the earth through which electricity cannot pass, it therefore follows that an oil pool in the path of the electric currents mentioned will offer a great resistance to the said currents; and we register these resistances on an extremely delicate meter in the hands of the operator on the surface of the earth."

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Coremaking and the Chemist

COREMAKING is the title of a booklet by Dr. Richard Moldenke which is now being distributed to foundrymen. It is a timely discussion of core-room practice and a detailed report of experiments and tests of a few of the many compounds now on the market, each claimed to be the material with which perfect cores can be made. In this work different sand mixtures, baking temperatures, etc., have been used with a view to aiding the foundryman to judge the material he buys and to use it most effectively.

A core is defined as a body of sand placed in the mold to form a corresponding cavity in a casting. Because it is nearly, if not entirely, surrounded by molten metal the core is subjected to considerable pressure and yet it must be so made as to allow the escape of steam and gases to the atmosphere thus preventing a "blow" in the work which would ruin it. The sand chosen is therefore of clean, round grains uniform in size which cannot be so packed as to prevent the escape of steam and gases. It is obviously necessary to use a binder which is so strong that but a small amount is needed so that it shall also not interfere with the venting. In many cases cores are also reinforced with wire, nails and bars.

Core binders are water soluble materials, pastes, gums or pitches, oils or colloidal and allied bodies. Of late, concentrated waste sulphite liquors from the paper process have been used, especially with clays; and the wood gums recovered from such waste liquors have also been employed. Molasses is one of the most widely used binders, while flour is still preferred in many shops. Later developments have tended to separate the binding agent from the flour or other cereal and use this active principle in any binders. Dextrine base materials seem to have come into much favor. Among the colloidal bodies clay is considered the best. Rosin is a typical gum often used in this work and tars stand for the pitches.

The best of the oil group seems to be linseed oil, although it is usually adulterated with cheaper vegetable and mineral oils.

In Dr. Moldenke's work seven representative binders were tried out with different mixtures of sand and at baking temperatures from 275 to 475 degrees Fahrenheit in some cases. Optimum conditions were established for each class of binding material and all in all the dextrine base binders are reported as the best for all around service.

The discussion will be found most interesting, and the point is clearly brought out that the core room offers really serious problems in the solution of which much research may be required in addition to careful control in practice and a better understanding of the basic principles in coremaking. The booklet is made more valuable by the inclusion of numerous tables giving data which should be available in all progressive foundries.

Fighting the Boll-Weevil

THE rapid march of the boll-weevil through the cotton belt of the United States has long been a subject of discussion and wonder. The Department of Agriculture and many other agencies have fought it and have tried to kill this highly destructive creature. While the accomplishments have given us cotton under conditions which otherwise would have worked considerable hardship, the boll-weevil has been successful in resisting extermination and indeed has not receded from his position.

Experiments which are reported from the Delta Laboratory of the Department of Agriculture at Tullulah, La., indicate that there may be a way to overcome this devastating pest and that the cost of the treatment may not be prohibitive. The material used was calcium arsenate dusted on the plants. Some reports indicate that the application of this chemical compound has reduced the boll-weevil infestation from 47 per cent to 30 per cent, and when weather conditions have been favorable the cotton has recovered to such an extent as to produce a bale per acre as compared with no cotton on similarly infested but unpoisoned areas.

To be sure there are many details to be perfected, both as to proper application and improved machinery for dusting. These must be within the reach of the small planter or groups of planters who can purchase equipment on some coöperative basis. The correct time to begin poisoning and the correct interval between dustings seem quite important in order to kill successive generations of the weevil, one pair of which are said to be the origin of seventy thousand individuals during a single season. To control and eventually exterminate the boll-weevil is of great economic importance, and it is with more than usual interest that the further experiments will be watched.

Atomic Forces

ONLY a few years ago it was the teaching that the atom was the smallest division of matter, and today scientists are discussing the possibility of the race learning how to use the force which would become available with the unlocking of the latent atomic power. Professor W. A. Noyes discussed the relations between atoms and electrons, which form a part of atoms, in his address upon being awarded the Willard Gibbs Medal, and stated that electrons probably rotate. This would make the atom a sort of miniature universe in which its nucleus would correspond to a sun and the electrons to the revolving planets.

Sir Oliver Lodge in a recent address also spoke of the latent atomic power which he considers so very great that it would be disastrous to have it become available to men before a moral plane high enough to prevent its abuse has been reached. He thought that a way to release this great power is not beyond the possible and some day it may supply a satisfactory substitute for that now obtained when molecules, made up of atoms, are shattered by combustion of fuel or other chemical processes.

Using Vegetable Seeds

EVERY year there is a considerable tonnage of grape, tomato, pumpkin and other vegetable seeds in the waste from canning factories and grape juice operations. Is there any use for these seeds? The necessity of separating them from the water pulp and skins and of assembling sufficient amounts for commercial operations introduces economic factors, but Dr. J. H. Shrader of the Bureau of Plant Industry has made investigations which indicate that these detail. can be solved. Thus a method has been tried on a small factory scale whereby grape seed can be separated from the pomace without recourse to drying, thus enabling the shipment of the seed to a central drying and crushing plant. This plant may be of a size to run a satisfactory length of time on the raw material available, or such a plant could engage in pressing other oil bearing seeds, such as soya beans.

The oil obtained from grape seed has been tested by scientists who have pronounced it to be edible and nutritious and, when purified, comparable to olive and cotton seed oils for a variety of food purposes. The press cake is said to be valuable as a stock food. Perhaps out of this work will grow some demand for the waste materials which will add materially to the income of the vineyard and the truck farm.

Reclassification of Scientists

BUREAU Chiefs and others responsible for the scientific activities of our government departments are continually handicapped by the gradual disintegration of their organization, due largely to the impossibility of retaining workers at the wage government service affords. Many continue out of a sense of duty and because of deep interest in the problems in hand, but this alone is not a proper basis upon which to found work that ought to be actively and continuously carried on over a period of years.

Serious attention is now being given the subject of proper and reasonable salaries for men in government work as compared with scientists and others having similar duties and responsibilities in the educational and business fields. The collection of data on the subject is now going forward and ere long the recommendations of the reclassification commission should help to formulate a policy enabling the United States to pay, for the indispensable scientific work conducted primarily for the people, what it is worth and what it commands elsewhere.

Research in the Cotton Industry

FOR some time research has been in progress here and there in the cotton industry. Part of it has been conducted by associations, much of it by government agencies, and not a little by textile schools and industrial laboratories. In England steps have been taken to form a Research Association in the cotton trade.

At the World Cotton Conference, held in New Orleans, October 13-16, and attended by representatives of many lands, the committee on Research, Reports and Statistics was able to discuss research from an international viewpoint. Cotton is one of the most important world commodities. It furnishes 90 per cent of our textiles and 100 per cent in some parts of the world. It yields cellulose for many chemical industries and the products of its seed become of greater economic importance daily. Cotton therefore is very much of a world problem, and the resolutions adopted regarding research follow:

"This committee recognizes the imperative necessity for all countries where cotton is grown or used to establish research institutions and urges that such institutions should work in close coöperation with each other especially in matters of fundamental research.

"This committee suggests that steps be taken to investigate in all sections of the cotton trade the most favorable hours of labor, rest pauses, fatigue and other conditions relative to efficiency and the preservation of the health of the workers.

"In view of the fact that it is upon the type and character of the cotton fiber that the results of all subsequent treatments are dependent and in view also of the present impossibilities of referring the commercial varieties to any definite strains, it is considered that the researches of most urgent and fundamental importance should be directed towards obtaining strains of definite types in order to make possible the correlation of the ascertainable characteristics of a fiber with the particular strain—pure or mixed—of which it is a member.

"With the increased interest at present taken in research work in the cotton industry and in order to derive the practical benefit of the work carried on by institutions undertaking research, this committee recommends that the work of such institutions should be brought into close contact with the various branches of the industry by carrying out work so far as is practicable in the factory.

"This committee recommends coöperative research in methods of testing fibers, yarns and fabrics with the object of securing, so far as possible, standard international methods, and urges a uniform system of expressing results.

"This committee wishes to point out the desirability of undertaking research to establish an international regain for cotton and cotton goods.

"This committee suggests to the International Cotton Federation that, at its congresses, the subject of scientific research be given a place on the program, and that the Federation consider the advisability of extending invitations to cotton research associations and others interested in such work."

With regard to the United States it is urged that the problems be considered by a small group which will endeavor to suggest a practical plan of work and prepare a budget for the consideration of all concerned. Obviously we must have a research association for cotton studies of domestic importance and to do its share in the world wide movement which seeks to improve cotton, to secure an adequate return for its growers and to create a supply to meet increased demand.

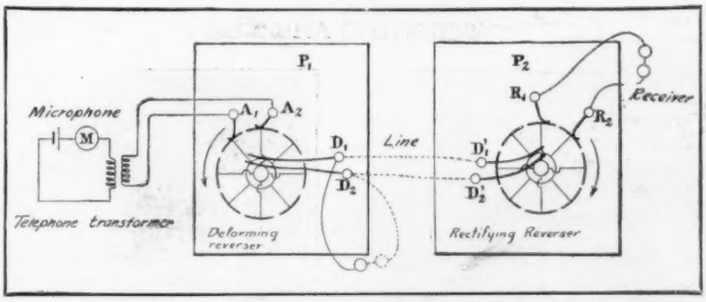
Chemicals from Kelp

AMONG the long list of materials obtainable from the giant kelp of the Pacific may be mentioned algin, which is now receiving much attention. The experience obtained during the war in harvesting and treating this seaweed has put the production of algin on a commercial scale within sight in this country. It is well known in Europe and should be in demand here. It is a substitute for many more expensive gums, glues, sizes, etc., and in various combinations answers a wide variety of purposes. The immediate problems have to do with purification and a more exact determination of characteristics in order that uses may be found which depend on qualities other than a low cost.

The Secret Telephone

By F. Honoré

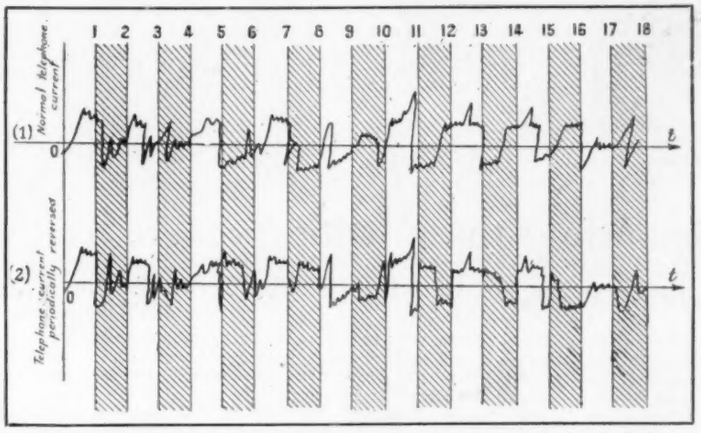
THE telephone is an element of modern life almost as important as the railroad; yet it presents the serious objection of lacking all guarantee of privacy. A wrong connection is all that is necessary to bring the ear of a third party into any wire conversation, while the employes of the central exchange are able at all times to listen in on business that does not in the least concern them, or even to extend facilities for such eavesdropping to a confederate with political, commercial or even criminal interest in what is being said.



The receiving and transmitting mechanism of the secret telephone

For a long time a means has been sought of overcoming this fundamental shortcoming of the telephone. The problem has seemed, *a priori*, one of the utmost difficulty, since all the subscribers of a given exchange are served by the same current and this current must flow over all the wires. In spite of this, however, a French officer of Engineers, Captain Poirson, has put forward a very elegant solution.

It is known that the electric vibrations utilized for the transmission of the voice must be of extreme purity, and that they must lie within a rather narrow range of frequency. Current of the sort that produces shocks on the diaphragm quite sufficient for the audible reception of a message in the Morse code is utterly incapable of transmitting the human voice. Captain Poirson, struck by these facts, wondered whether it would not be possible systematically to deform the telephone current at the point of origin of the message, in such a way as to render the conversation which it carries unintelligible all along the line; then to restore it, at the intended point of reception, to its previous form, in such a way as to make the words distinguishable again. To accomplish this it would be sufficient to develop a deforming apparatus which would be reversible, so that when attached to the receiving instrument it would undo the work of its mate at the transmitter, and restore the current to its original character.



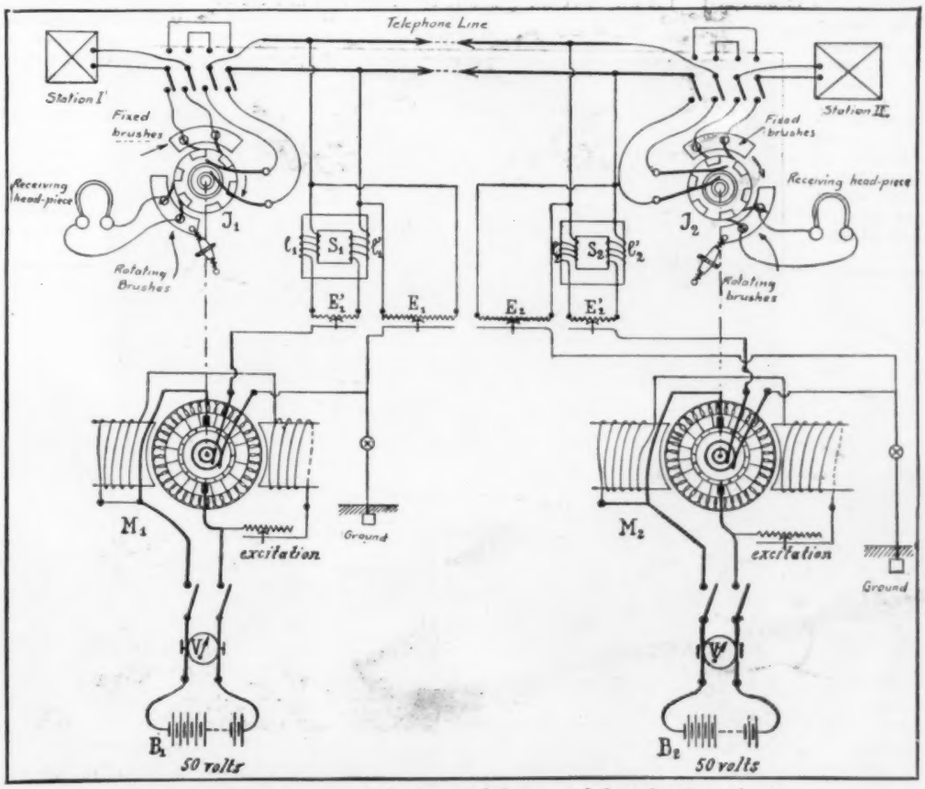
Oscillographs showing how the telephone current is reversed (in the shaded intervals of the second curve) for purposes of secrecy

Deformation is easy enough to effect. We need only reverse the waves periodically, as is shown in our two oscillographs. The one represents a normal telephone current, the other a current which has been periodically reversed. In the latter instance we see that in the intervals 0-1, 2-3, 4-5, etc., no deformation has taken place, while in the intervening intervals 1-2, 3-4, etc., the current has been turned over, crest and trough of the electric waves having been interchanged. Experiment has shown that the greater the frequency of the inversions, and accordingly the shorter the duration of the reversed intervals, just so much the more complete will be the resulting confusion. Up to a frequency of 100 periods per second the words remain distinguishable; above this point they become less and less clear; at 400 periods the deformation is complete.

The second operation, the reconstruction of the original current, is much less easy. To obtain this result it is necessary that perfect synchronism exist between the movements of the deforming and the reforming apparatus at the two ends of the line, so that inversions shall be produced at the same time in the two outfits. This condition has been attained by means of rather complicated electrical arrangements, of which the complete details have not been made public. We are able only to say that the principal element of the apparatus consists of a rotating commutator which rotates and inverts the current, and of which our diagrams indicate the mode of operation.

We may add that the deformation is so characteristic that one can, at the point of intended reception, adjust the apparatus to render the words intelligible, without knowing the language which is being spoken. Experiments have been made with success upon a number of the French lines, notably that from Paris to Bordeaux, 615 kilometers in length. The synchronism, even on the poorest circuits, has invariably been satisfactory.

It was at first supposed that, once the general method of procedure was known, it would be possible, by means of a similar apparatus installed at a clandestine receiving point, to steal and decipher a communication. Captain Poirson, however declares that he has found a way to make this particular form of petty larceny impossible—but that in view of the existing international situation and the extreme importance of such a scheme for telephone secrecy this phase of the matter must for the present remain a military secret.



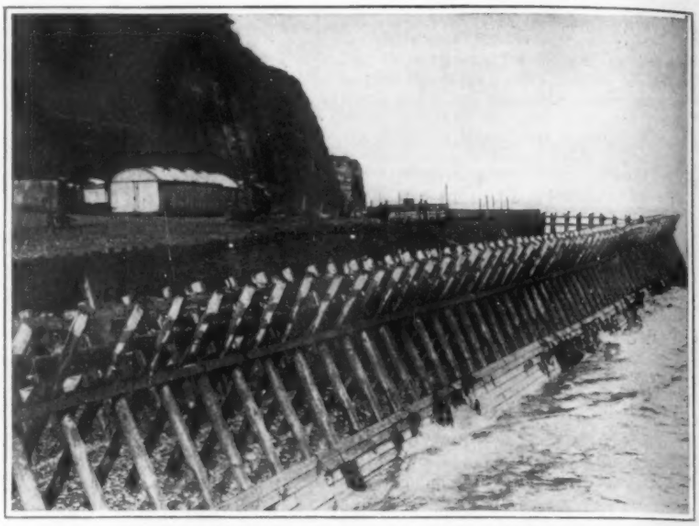
The electrical arrangements of the current deformer and the reforming apparatus

Are Sound Waves Ever Visible?

CONSIDERABLE interest has been shown in Europe of late with respect to the possible visibility of sound waves. The May number of *L'Astronomie* relates some curious incidents which seem to indicate that such waves are sometimes perceptible to the eye. A well-known authority on volcanoes, Mr. Perret, relates that after an eruption of Vesuvius he has hundreds of times observed the appearance of luminous and shadowy arcs above the crater subsequent to explosions, these arcs being visible before the arrival of the sound and disappearing rapidly. "The only explanation" says Mr. Perret, "which accords with the characteristics of such a phenomenon is the theory that we are here concerned with visible waves of sound, whose speed of propagation corresponds to that of sonorous waves."

Another interesting observation was made by Lieut. Arnulf, with regard to a battery which was in action September 26, 1918. The observer was looking at the battery in profile, facing the sun, which was on the other side of the gun. "At the very moment of firing, upon the appearance of the flame," states the officer, "a shadow made its appearance and was propagated over the surface of the ground in the form of the arc of a circle, the center of the circle appearing to be located at the gun and the radius increasing with great rapidity. The width of this shadow appeared to be about 0.80 meters in the case of the 75's. This width was two or three times as great in the case of the 155's and furthermore the shadow appeared to be deeper, so that the phenomenon was much more remarkable in the case of guns of the latter caliber than in the case of the 75's. The rapidity of propagation of this shadow was very evidently the same as that of the sound. It was in fact extremely curious to hear the noise of the shock at the very instant when the shadow reached our feet. The farthest gun might have been at a distance of from 300 to 350 meters (300 meters is undoubtedly too low an estimate). Thus the sound quite perceptibly required one second to reach me, a very appreciable length of time, and one long enough to measure with some accuracy. I believe I am justified, therefore, in estimating the rapidity of travel of the shadow to be equal to that of the sound."

Seawall with concrete block riprapping



Temporary timber breakwater on east side of Heligoland

Dismantling the Fortifications of Heligoland

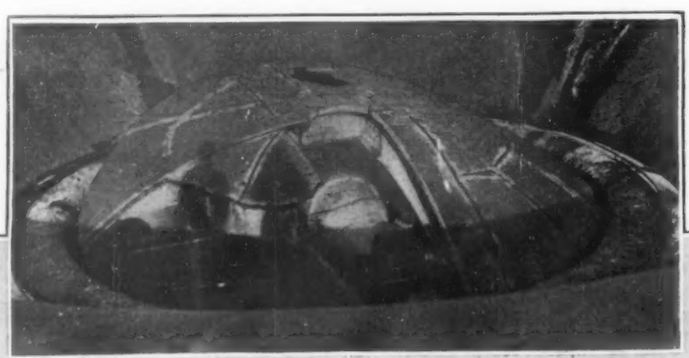
How the Germans are Carrying Out the Terms of the Peace Treaty

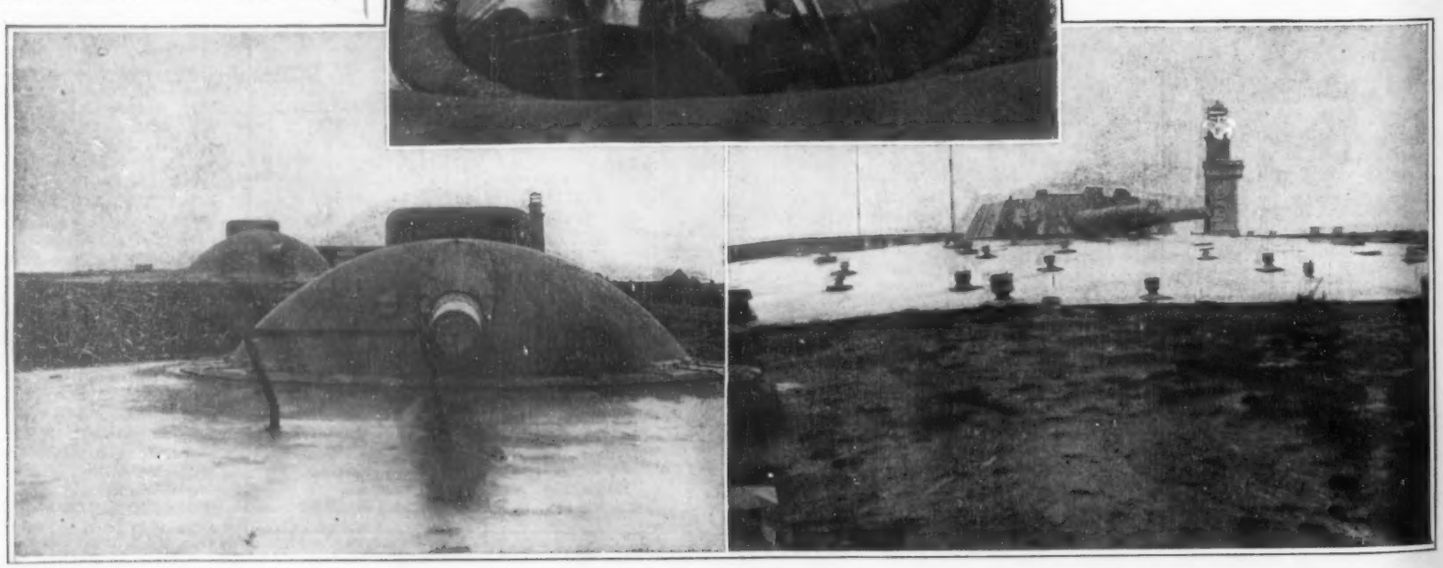
ONE of the terms of the Peace Treaty calls for the complete dismantling of the fortifications of Heligoland, and we present some photographs of recent date, one of which shows the process of demolition actually in progress. The strategic value of the island lies in the fact that it lies in the Bight of Heligoland, and in connection with the fortifications of the mainland, covers the approaches to the Elbe and the Kiel Canal. The island, which is about a mile in length and less than a third of a mile in width, came into the possession of the British during the Napoleonic wars and remained in their hands until 1890, when it was ceded to Germany in return for certain important considerations, and since this monumental blunder it has formed part of the German province of Schleswig-Holstein. The bulk of the island consists of a mass of sandstone rock with perpendicular cliffs, the surface consisting of a flat tableland. After taking possession, the Germans dismantled the old British fortifications of great strength, the principal element of which was batteries of heavy, long-range rifles and howitzers, mounted either within the well-known Gruson type of turret or within turrets of the naval type. These batteries were very complete, with subterranean magazines and shelters for the gun detachments, and, of course, they were provided with the latest range-finding and fire-control apparatus.

The distance from the island to the mainland is about thirty miles, and the batteries of heavy guns both at Cuxhaven and on the opposite coast were of such range that the arcs of fire overlapped and constituted a very powerful defense against the operations of an enemy fleet.

The defense was also favored by the fact that the channel entrances on either side of the island are tortuous and flanked by comparatively shoal water. In general, the height of the island is about 200 feet and the inhabitants which, normally, numbered about from 2,000 to 3,000, lived in the upper town upon the tableland, and in the lower town at its base on a low lying spit of land. Here a thoroughly protected artificial harbor had been created which formed an excellent shelter for shipping and during the war was used as a submarine and destroyer base.

To those people who are disturbed by the foolish chatter in the press and elsewhere to the effect that Germany has not been defeated, does not consider herself defeated, and is still militarily a strong nation, we recommend a study of that picture among the present group which shows the cupola of one of the German howitzers in position at Heligoland being cut apart by means of the oxy-hydrogen torch, the course of which can be traced on the shield, showing where the torch has cut through, severing the armor into small sections suitable for handling. Dismantling is evidently under way at Heligoland. These photographs have just come over from Germany, and they prove that the German people at least have enough sense to realize that the course of wisdom for them is to comply with the terms of the Armistice and the Peace





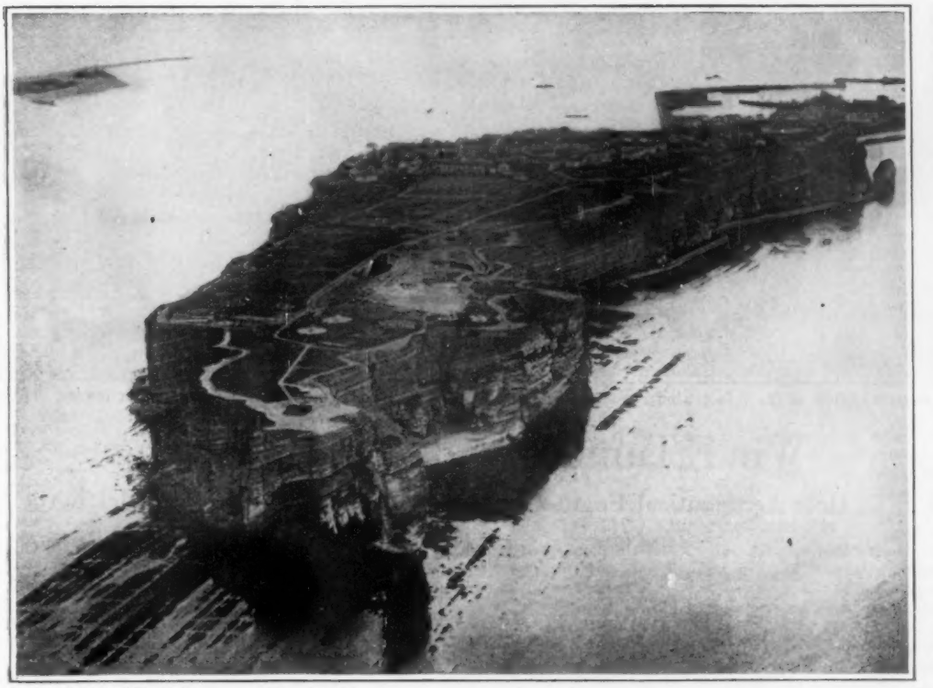
All photographs on this page, copyright, International Film Service

At the left: Big gun in cupola turret mount. *At the right:* Pair of heavy guns in naval mount. *Center:* Cutting up the cupola of a howitzer with oxy-hydrogen torch

Some of the big guns of the Heligoland fortress that are now being dismantled

Treaty, which their duly elected representatives have signed.

Heligoland not only formed a most powerful outlying defense for the Kiel Canal and the Elbe, but also for the main German High Seas Fleet. From the Elbe and the Canal this fleet was able to support its own mine-laying squadrons, and to threaten the mine-layers and mine-sweepers of the enemy.



Copyright, International Film Service

View of Heligoland, looking south. The two white circles near North Point are two heavy-gun turret emplacements

Wealth from Waste

By Theodore Ruete

TO clear many square miles of valuable land of mountainous rubbish heaps, by the employment of a process for utilizing the waste material is an instance of killing two birds with one stone that does not occur in the industrial world every day. This oft-desired consummation, however, is what is being accomplished at the present time at Bethesda and other places in North Wales by the owners of extensive slate quarries. For some time past, exhaustive and many-sided experiments have been carried on at this company's works with the dust obtained from crushing the slate-waste resulting from the manufacture of the superior roofing-slates they turn out there.

These trials have proved so satisfactory that steps have now been taken to establish the industry on a commercial basis. All around the North Wales slate quarries lie millions of tons of slate waste, which can now be converted into fine inert powders from twenty mesh up to two hundred mesh and above, for use in the manufacture of asphalt, bricks, cement, abrasive soap, cleansers, glass, linoleum, tiles, rubber goods, mantels, pottery, paints, slabs, insulators, and other manufactured articles requiring weather-resisting and good wearing qualities.

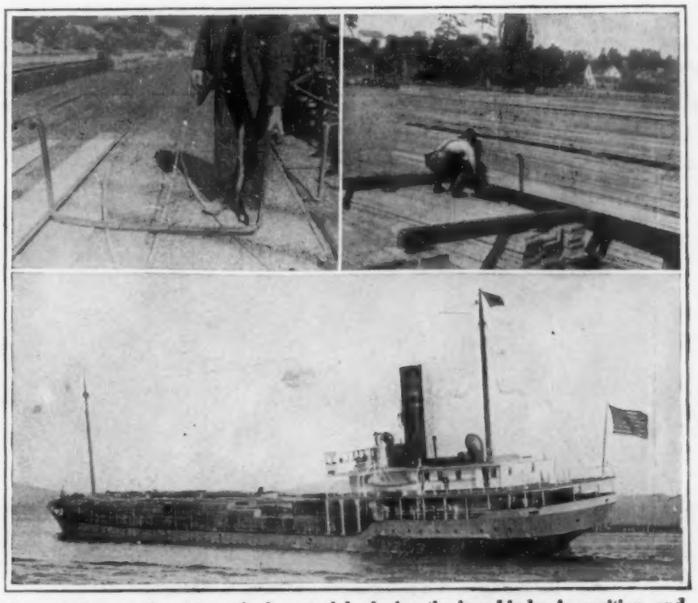
In view of the reconstructive and rebuilding operations now proceeding all over Europe a very wide market is envisaged for the powders, with the production of which alone, except for the manufacture of bricks, the company will concern itself. The works have at present only an output capacity of 100 tons per week, but the manufacture of the powders has proceeded far beyond the experimental stage, as has been proved by the large number of orders for many hundreds of tons each, many of them repeat orders, especially as a filler for asphalt and rubber goods; the powder being already an assured success as regards its use for asphalt.

Machinery will shortly be installed for the making of the bricks at the rate of 8,000 to 10,000 per day. Those bricks at present being turned out at the works are unsurpassed in denseness, strength, and hardness and possess a crushing weight of 16,500 pounds to the square inch; while the tests made of the slate dust as a "filler" for low-grade rubber goods, such as baby-carriage tires, boot soles, etc., have proved perfectly satisfactory.

It is, however, for the manufacture of Portland cement that the largest use of the company's new product is anticipated. In this connection it may be noted that official experiments carried out with the slate materials produced a cement of higher grade than any that had yet been put on the market. In Great Britain, the breaking-strains fixed by the government, below which standard cement may not be sold, are 450 pounds to the square inch after seven days' settlement, and 755 pounds to the square inch after twenty-eight days' settlement. Under trial, the cement made from slate dust and lime withstood strains of 700 pounds per square inch after seven days' settlement and 796 pounds per square inch after twenty-eight days' settlement.

In anticipation of the great industry now likely to spring up for making use of this plentiful slate-waste, building operations for huge plants in various places are already under way, all the bricks and mortar for which are made from the company's slate-waste powders. At least one of these plants will contain a machine which will combine in itself all the processes, now carried out by three, of grinding, screening and sifting the waste into the powders as at present manufactured. In another slate-waste center a giant American crusher is about to be set up, which will take any size of slate-waste blocks and reduce them to uniform sizes suitable for the varied capacities of the other machines.

Lengthy as is already the list of the uses that can be found for this wonderful product, however, it is by no means yet exhausted. In addition to the larger and grosser objects for which it will be employed the dust has also been found to form an excellent base for such dainty articles as toilet-powders, tooth pastes, and disinfectant powders, which, perfumed and colored just as are the ordinary articles of this nature in common use, can then not be distinguished from such. For the slate-waste possesses this useful peculiarity, that it can be ground into eight distinctive grades of powder, each successive one finer and softer than the previous one, till at last the resultant dust approximates very closely to vapor.



Iron binders made of 1 x 2 inch material, placing the iron binder in position, and the steamer "Adeline Smith," a special lumber-carrying ship

Utilization of Marine Plants

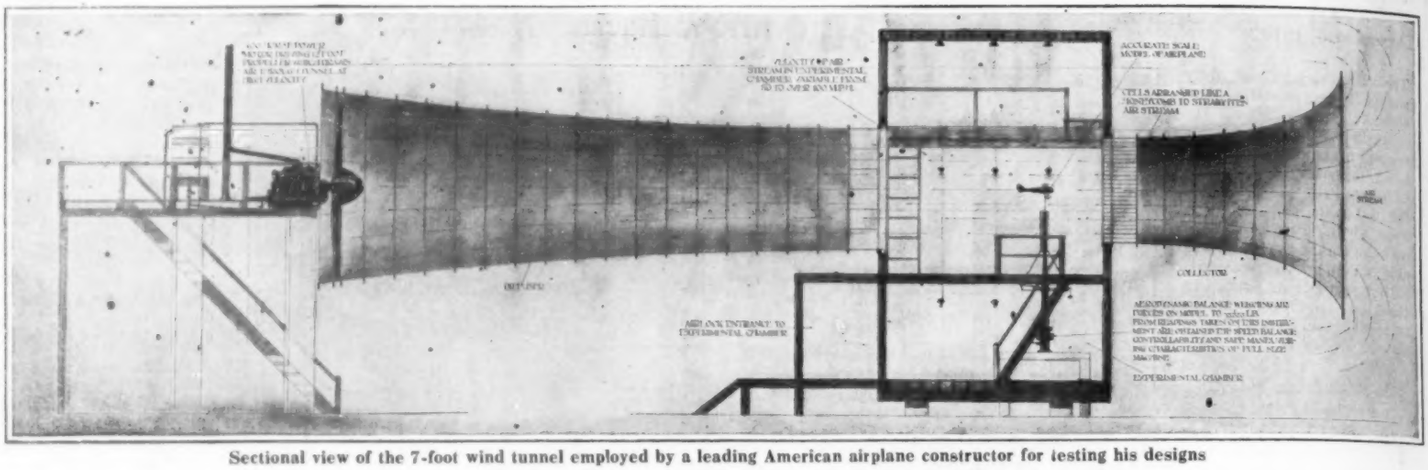
ALL rivers run eventually to the sea, bearing with them their precious burdens of dissolved or suspended organic or inorganic substances. Mankind has long realized that for this reason the ocean is necessarily a vast treasure house of infinitely varied wealth. Many have been the schemes in fact for extracting gold from sea water. These dreams have thus far failed of fulfilment but it is more and more coming to be understood that the ocean is indeed an infinite treasure house of living gold in the diverse flora and fauna which it contains. Some time ago the French scientist, M. A. Chatelier, made a study of the marine plants capable of being used as a source of cellulose and paper. More recently M. P. Gloess has described in the Bulletin of the Oceanographic Institute the various possible utilizations of marine plants. In the first part of the article he shows that such plants can be used in general for fertilizers and as sources of nitrogen, potassium, phosphate, oleomargarine, etc. In the second portion he treats of the *Zostcres* from which cellulose and paper can be made with a by-product of a fertilizer containing both nitrogen and potassium. He next speaks of the red algae or *Florideae* from which agar-agar is extracted. But the largest part of his article is devoted to the brown algae from which the foodstuff algine can be extracted, while both this and the alginates can be used in industry for various purposes as a mordant.

A New Italian Industry

A NEW industry has just been introduced at Milan. It consists in the manufacture of collars, cuffs, cigarette and other boxes, carpets, purses, furniture coverings, wall-paper of the "Anaglypta" type, and such like from waste leather cuttings, which have hitherto been useless. Henceforth they will be worked up by special purposes into various articles, and into such decorative media as have hitherto been made in leather.

Unit System Speeds Up Handling of Lumber

Handling shipments of lumber by the unit system is rapidly developing on the Pacific coast and is resulting in speeding up the work immensely. The lumber is handled in units by means of iron slings, being hoisted aboard by an electric crane. These binders are left on the loads after being placed on the boat; thus the same binder that is used to place the load on board is employed to lift the load off the boat. At the destination the lumber is unloaded as rapidly as it is loaded, at the rate of about 2,000,000 feet a day. One of the vessels operating between Coos Bay, Oregon, and San Francisco and carrying 1,450,000 feet of lumber, makes a round trip in about five days. This boat can be given a full load in 12 hours and on some trials this work has been done in 10 hours. The unit system nearly eliminates the human element in the great work of loading and unloading.



Sectional view of the 7-foot wind tunnel employed by a leading American airplane constructor for testing his designs

Wind Tunnels and Airplane Designs

How Aeronautical Engineers Check Up Their Designs in Model Form

EXCEPT for the very fine work done by such early experimenters as Lilienthal, Maxim, Langley and Wright, the first airplanes and not a few of some of the later ones were built by "rule of thumb"—by the old method of "cut and try again." It is remarkable that some of these machines performed as well as they did, but it is certain that many a poor fellow lost his life for want of a little knowledge of the laws of aero-dynamics, the nature and direction of stresses, and the strength of materials.

It was not long after the first man-controlled, motor-driven airplane had flown before the scientist and the engineer laid their hands upon the new art and began to bring order out of chaos. "Rule of thumb" and "cut and try again" began to give way to the testing machine and the wind tunnel, and flight ceased to be any longer a matter of playing a game of hazard with death.

The wind tunnel has answered definitely a hundred questions to which, before its advent, answers were either indefinite or quite misleading, and the most successful machines from the aero-dynamic standpoint, and indeed, if the workmanship be good, from any standpoint, are those which were born in a wind tunnel. The accompanying illustrations were taken at the research laboratories of the Curtiss Company at Garden City, where are to be found three wind tunnels, one of which measures two feet by two feet by eight feet in length, another four feet by four feet by forty feet in length, while the third and largest is seven feet in diameter by seventy feet in length. The four-foot tunnel is impressive; but when one enters the large building containing the seven-foot tunnel and stands looking into its great mouth and the eye ranges down the full seventy-foot length of the structure, one realizes what care, trouble and cost are involved merely in determining the parts and proportions of the various elements that go to make up a first-class flying machine.

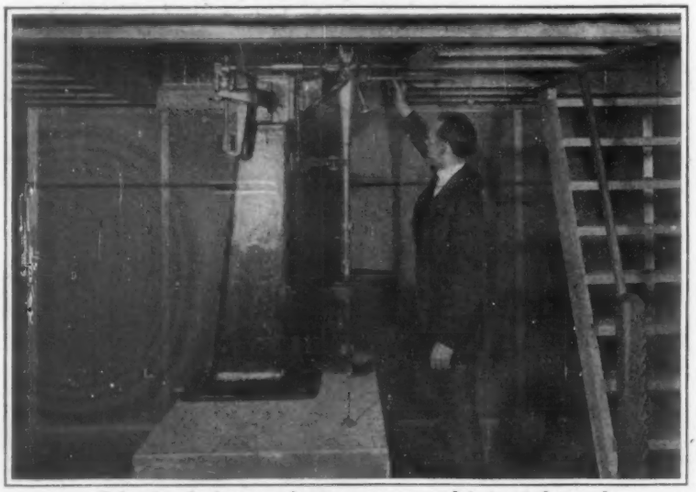
The seven-foot tunnel, which has a diameter of fifteen feet at its bell mouth, leads to a large rectangular experimental chamber. The air stream passes through this, and then continues through the after section of the tube to the four hundred horse-power motor, which by means of its four-bladed propeller, draws the air through the tunnel at any desired velocity up to one hundred miles per hour. Inside the experimental chamber is mounted an aero-dynamic balance which weighs to one ten-thousandth of a pound the pressure exerted by the air stream upon the model. The balance consists of a vertical shaft pivoted somewhat below its mid-length and free to oscillate in a vertical plane parallel to the axis of the tunnel. At the top of the shaft is placed a perfect and most accurately made model of the full-sized airplane. The 7-foot tunnel can take models up to a three-foot span. As will be seen from our drawing of the tunnel, it is entered on its lower floor by means of an air lock, and on this floor is a working table and all the conveniences in the way of electric light, et cetera, for the operators.

It must not be imagined that these tests determine merely the horse-power necessary for a given speed. That is an important element of the problem, but it is only one; for by means of the readings taken on the aero-dynamic balance, it is possible to determine the speed, balance, controllability and safe maneuvering characteristics of the full-sized machine.

It was in this tunnel that the data for the construction of NC-4, the seaplane which first crossed the Atlantic were obtained. In this case the model was one-sixty-fourth of full size, and it was tested in a wind stream of sixty miles per hour. In order to obtain the resistance of the full-sized machine, it was only necessary to multiply the pressure obtained on the model by the square of sixty-four.

The construction of the tunnel is quite original and has proved to be very satisfactory. It is built up of longitudinal strips of compo-board one quarter of an inch in thickness, which are laid upon a series of polygonal supporting rings, built up of boards ⅞ inch thick by four inches wide. This gives a very stiff and light construction. Another novel feature is that the tunnel is not supported from below, but is suspended from above by means of stout wires which are so disposed that the tunnel is absolutely free from sway or vibration.

It must not be supposed that the work of the tunnel is confined to the testing of complete machines. It is used to determine also the best shapes for the fuselage, for struts, wires and individual wing sections, and perhaps the best attribute to the efficiency of the work that has been done in this tunnel by Dr. Coffin, who is the head of the research laboratories and was responsible for the design of the tunnel, is the records which have been captured by the wonderful little triplane, the "Wasp," which holds the record for straight-away flight near the ground of 163 miles per hour, and also holds the record for ceiling or height of 34,610 feet.



Balancing device records pressures on models in wind tunnel

Production of Power Alcohol in British Empire

THE report of the British Inter-Departmental Committee on the Production and Utilization of Power Alcohol, which was recently made public, recommended the establishment of a Government organization to initiate and supervise experimental and practical development work on the subject, and the London *Times* states that such an organization, with funds, is to be set up under the Department for Scientific and Industrial Research.

The report also refers to the possibility of obtaining large supplies of alcohol synthetically from the products of coal distillation. The gases produced from gas retorts and coke ovens contain about one-half of 1 per cent by weight of ethylene, and a process is being worked out for collecting this ethylene and converting it into alcohol. For extracting it use is made of the property possessed by cooled charcoal of absorbing gas, and the charcoal, when charged with the gas, is carried in a stream of molten lead, the heat of which causes it to give up the ethylene, which is then treated catalytically for the production of alcohol.

The amount of ethylene in the gas works and coke-oven gases of Great Britain is estimated to be sufficient to yield annually up to 150,000,000 gallons of 90 per cent alcohol, which, the *Times* declares, the manufacturer could afford to sell for 1s. 3d. [30 cents] a gallon; and even if it were found impracticable, owing to such difficulties as that of collecting the ethylene from all the gas works (many of which are small and are situated in remote districts) to treat only half the total produced, some sixty or seventy million gallons would be obtained. Already several important collieries are believed to have in hand the addition of conversion plant to their existing coke-oven installations.

Alcohol by itself, the *Times* continues, is not suitable for use in existing types of high-speed internal-combustion engines, such as are fitted in motor cars, but mixed with an equal amount of benzol it forms an excellent fuel for the purpose. Some difficulty in starting the engine in cold weather is the chief disadvantage, but, on the other hand, even more power is obtainable than with an equal consumption of gasoline. The present production of 90 per cent benzol in this country is at the rate of about 31,000,000 gallons annually, and may in the near future be increased to 50,000,000 gallons or more.

The outstanding and fundamental attraction of alcohol motor fuel as a substitute for any fuel necessarily derived from coal or oil deposits lies in the fact that on account of its chief sources being found in the vegetable world, supplies of raw material for its manufacture are being continuously renewed in many quarters and are easily susceptible of great expansion.

Bleriot Aerial Bus

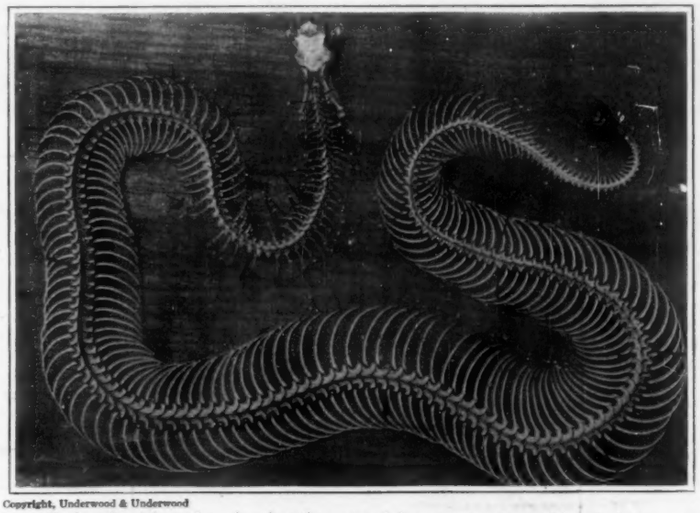
IT is many years since the name of Bleriot has been connected with aerial developments. Yet that pioneer has never relinquished his interest in flying, and just lately he has turned his attention toward the large airplane for passenger-carrying purposes, with the result shown in the accompanying illustration.

Bleriot aero bus, which has a passenger-carrying capacity of 28, between two single-passenger scout machines

The Bleriot bus has four engines of 250-horsepower each, arranged as shown. It will be recalled that this arrangement of engine units was used in the Tarrant triplane built in England. The huge triplane was wrecked while attempting its initial flight, the reason for the accident being that the upper set of engines worked better than the bottom set, with the result that the machine was pulled nose down. It may be that the designer in this instance has guarded against such a condition, and has persisted in this design because it affords the best airscrew efficiency, according to aeronautical experts.

The Backbone and Ribs of a Snake

JUDGED by its external appearance, it would seem as if the snake had very little if any backbone. Yet the truth of the matter is that a snake has a most complex skeleton, as may be gathered from the accompanying illustration, which shows a "rattler" when stripped of all its flesh and skin. This is a remarkable example of fine model mounting for museum purposes.



Copyright, Underwood & Underwood

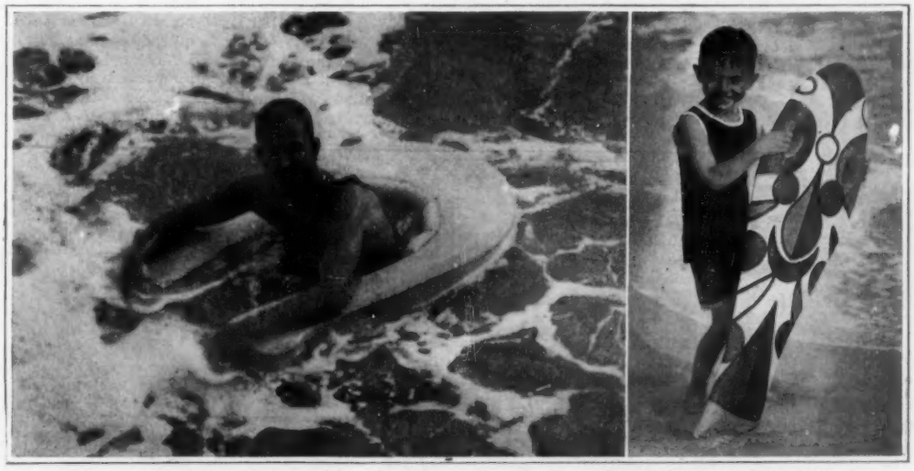
Stripped rattlesnake, showing the very elaborate structure of its skeleton

New Uses for Balsa Wood

FOLLOWING its extensive application in airplane construction, balsa wood is now being used for other purposes with considerable commercial success. Balsa wood, it need hardly be mentioned here, is the lightest wood known—so light, in fact, that a child can readily carry a beam as large as a railroad tie.

In the accompanying views are shown two interesting applications of balsa wood to surf sports. The first shows the "floating chair," which is nothing more than a horseshoe-shaped float provided with straps affording a comfortable seat. The user can sit in comfort while floating about on the waves.

The second illustration depicts a fish-shaped surf-board for coasting on the waves, also made of balsa wood. This surf-board is so light that it can be carried about by the little chap who is playing with it.



The floating chair and the surf-board—two novel applications of the lightest of woods, balsa

Can Copper and Tin Be Recovered from Brass and Bronze?

JUST how the German metallurgists succeeded in obtaining or recovering copper from its alloys, brass and bronze, to replace the copper shortage during the war has been very interestingly revealed by a leading German metallurgist.

The problem was to obtain a pure copper from the miscellaneous alloys which the mobilization of copper brought in. Several copper refineries were built in Germany and Austria, notably by the Siemens companies. The brass utilized comprised door brasses, candlesticks, picture frames, taps, weights, crucifixes, etc.; the brass was melted down, the zinc oxidized, and the crude copper cast into anodes and treated in the electrolytic refineries. The requisition of bronzes, largely church bells, followed that of brass. The disintegration of the heavy strong bell metal gave some trouble; the bells were inverted, filled with water and then shattered by exploding cartridges in the water. The bronze was then fused into anodes for electrolysis. The accumulation of stannic acid in the anode mud and in the electrolyte disturbed the electrolysis, and some copper was first lost and recovered contaminated with lead and other impurities; those difficulties were, however, eventually overcome.

The recovery of tin was another difficult problem. Germany possessing hardly any tin ores, the stannic anode mud had to be reduced to tin, and special attention was further paid to the recovery of tin from bearings metal. Two works were built to work up old bushings, and it is said that they have been very successful, and that some works have also managed to economize tin by adopting electrolytic processes in their tin-plating shops. That zinc and aluminum have widely been used in the electrochemical industry has been mentioned on other occasions. There has been no important modification of the aluminum process. But the foreign supply of bauxite was stopped, and the best use had to be made of the bauxite stores of Carinthia, Hungary and Dalmatia and of superior clays in other parts of the Central States. Reliable particulars about the purification of clay have not yet been published.

Improving the Efficiency of Boilers

EARLY in 1918 Mr. F. W. Dean, of the Emergency Fleet Corporation, made the request to the Bureau of Mines that it furnish the personnel and equipment to make determinations of the temperatures existing in the gases throughout the setting of a boiler. This was to be done in connection with the test of a boiler which the Corporation was conducting at Erie, Pennsylvania. Mr. O. P. Hood was in charge of the test and Henry Kreisinger was detailed to make the determinations. The results obtained clearly indicated the necessity for further work on the problem of boiler efficiency.

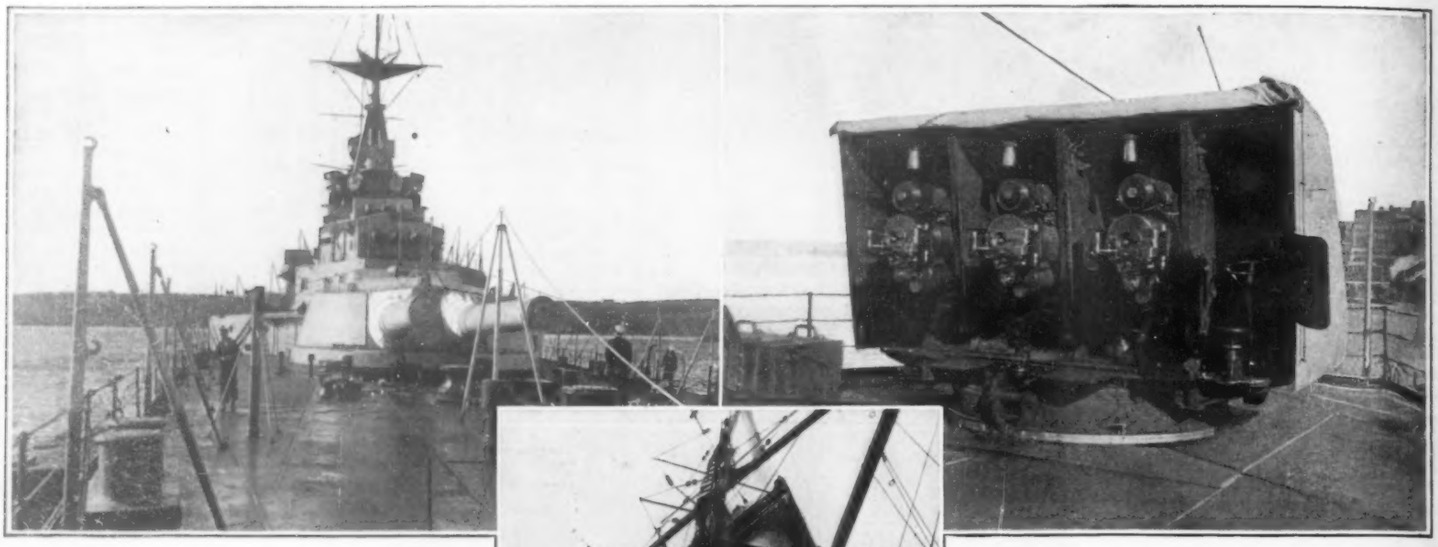
The fact is not generally appreciated that sufficient air cannot be admitted through the fuel bed of a hand-fired furnace to provide for complete combustion. This fact is independent of the kind of fuel used or the rate at which air passes through it. Unless there are holes in the fuel bed through which the air can pass without coming in contact with the fuel, there is always 20 to 32 per cent of combustible gases with no free oxygen to burn them. This important fact is generally overlooked, because in ordinary furnace practice there are so many holes in the fuel bed and so many leaks around the furnace doors and in the boiler setting that an excess of air commonly exists in the flue gases. In other words, two errors compensate for each other so that the existence of one is masked. The excess air which leaks into the furnace, however, does not usually serve the purpose of bringing about complete combustion of the fuel, because it is not properly mixed with the combustible gases, nor is it under control as to quantity. In other words, for proper combustion excess air should not leak through holes in the fuel bed, but should be introduced above the fuel bed in such a way as to bring about complete combustion of the gases.

Another point revealed by the temperature measurements was that changes in the design of the baffles were necessary in order to provide for proper absorption by the boiler surfaces of the heat in the gases. In boiler practice the design is commonly made from empirical data and not from exact determinations, so that the baffling of the gases to guide and retard their passage through the boiler setting until their heat is absorbed with maximum efficiency is not properly accomplished by the means usually pursued.

As a result of the information obtained from temperature measurements and gas analyses the design of the boiler was so modified that six tons of coal were enabled to do the work of seven. The excellent results obtained from these tests led to tests of boilers of different design at other places, and has also led to the request from the Sinclair Oil & Refining Company of Chicago, for a similar investigation to improve the efficiency of the stills used in refining petroleum. These, it is well known, are very inefficient in their use of fuel, and as the equivalent of many thousands of tons of coal are used annually for this purpose a further important saving may result.

The British Battle-Cruiser "Renown"

Some Particulars of the Fastest Big-Gun Ship Afloat



Some characteristic views of the "Renown"

At the left: View on the quarter deck, showing two 15-inch guns. *At the right:* One of the three-gun mounts developed by the British during the war. *Below:* Top of forward tripod mast

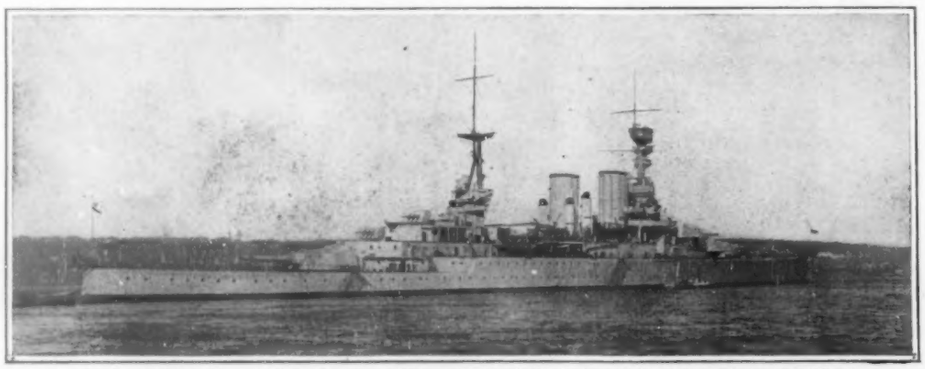
IN selecting the battle-cruiser "Renown" to carry the Prince of Wales to America, the British Admiralty chose a handsome and popular ship to carry a gallant and popular prince on a tour of good-will. "Renown" has grace in every line of her, so much so, indeed, that one is apt to forget that she carries six of the most powerful guns afloat today. It is easier to credit her speed than her gun power, for she is both long and lean, and in spite of her great size, she has all the sweetness of line and delicacy of modelling which characterize the yacht. How big is she? Well, perhaps there is no better standard of measurement than the Woolworth Tower, which is exactly as high as the "Renown" is long, namely 789 feet. Moreover, she is within a foot or two of being the same length as the "Mauretania," although there the similarity ends, for the "Mauretania" has been driven by her 70,000 horse-power turbine at a maximum speed of 26 knots, whereas the "Renown," with her 112,000 horse-power, made on her trial trip 32.6 knots, which is equivalent to about 38 miles per hour. As might be expected, in order to achieve this speed, the "Renown" was given the fine underwater lines of a destroyer. It has been stated that except in her bottom plates, there is not a straight line in the whole hull of the ship, and to the practised eye, a great similarity is shown between her lines and those of the latest destroyers. There is a suggestion of her fineness in the fact that in spite of her length, she displaces only 26,500 tons, and her draft is only 25 feet 6 inches. Originally, this vessel and the "Repulse" were laid down as battleships, and work had only just commenced when war was declared. As a result of the success of the British battle-cruisers in finding and sinking Admiral Von Spee's fleet at the Falkland Islands, it was decided to build the two ships as battle-cruisers, giving them greater speed and a heavier armament than the existing ships of that class.

The "Renown" embodies many of the lessons learned in the war, including a modified bulge below water as a protection against torpedoes. In fact, the whole matter of anti-torpedo defense has been well worked out, the protection of the bulge being supplemented by elaborate internal subdivision of the hull of the ship itself. The armament consists of six 45-cal., 98-ton, 15-inch guns, firing a 1,920-pound shell. Both the guns and the turrets are worked hydraulically, and an opportunity to watch the operation of the guns was afforded to visitors as the ship lay in the North River, New York. One stroke of a plunger located on the gun above the breech block unscrews the latter and swings it open. The guns are elevated by the direct action of a plunger attached below the breech. The bringing up of the heavy ammunition is also done by hydraulic power.

A novel feature is the installation of the four-inch anti-torpedo battery in three-gun shield mounts, a compact arrangement which is in line with up-to-date development. An interesting feature is that this secondary battery of 17 four-inch guns is controlled by special director-firing methods from the foretop.

The British system of firing is to let go with only the right-hand gun in each turret, which in the "Renown" means a three-gun salvo. The next salvo consists of the left-hand guns in each turret, and the third salvo of the right-hand guns. The range for the second salvo is raised 500 yards over the first, and the third is raised 500 yards over the second. The salvos come so rapidly that when firing at, say, 15,000 yards' range, there will be three of these salvos in the air at the same time. When they land, the splash lays a scale, as it were, down upon the water near or around the enemy, and from the three shots, the fire-control officer can determine the range for the next salvo. It is known among the British as the "ladder" system.

One of our illustrations shows the top of the forward tripod mast. The three covered-in platforms contain the fire-control instruments and are occupied by the officers who do the spotting, ranging, et cetera, by which the position and course of the enemy ship are determined. The motive power consists of water-tube, oil-fired boilers and Brown-Curtiss turbines. The oil is stored in the double bottom. When the "Renown" is fully fuelled for a voyage she carries 4,250 tons.



Battle-cruiser "Renown" in the North River, New York, during visit of the Prince of Wales

Length, 789 feet; *displacement*, 26,500 tons; *speed*, 32.6 knots; *armament*, six 15-inch, seventeen 4-inch guns

Exploitation of South-West African Diamonds

MINING interests on the Rand have recently devoted much attention to the possibilities of developing the diamond mining industry in South-West Africa. According to the *Board of Trade Journal* a concession for the exploitation of certain areas (which stretch under the sea) has been granted to a well-known Rand company. Under this the company has acquired seven areas in the Pomona district and one near Luderitz, to the northwest of Kolmanskop, altogether approximately 5,000 acres.

Underneath the sand on one area in the Pomona neighborhood a conglomerate of lime and fine sand has been exposed. The test of this conglomerate has yielded, it is stated, 65 carats per 100 loads. The conglomerate, from its appearance, is simply the hardened ocean bed, and investigation by experts indicates that it contains larger gems than those found in the sand. The diamonds recovered are described by the experts as clear white and white with a yellow tinge.

The original purpose of the company was to dredge the ocean bed in the neighborhood of Possession Island, which will require the erection of a landing stage on the mainland.

Biting off what you can do

The business where orders mean more than deliveries and where personal profits outweigh public benefits has a weak foundation and a stunted growth.

The business that serves *thrives*.

Blaw-Knox Company accepts orders only when it can deliver a saving in time, money or equipment with its product.

Blaw-Knox Company believes in its methods to the extent of first having its engineers investigate the purpose which its product is to accomplish. Then furnishing or designing the equipment which fits exactly. And finally seeing that it *does* accomplish.

When a subway, sewer, wall, warehouse, road, sidewalk or 'most any other concrete structure is to be built, Blaw-Knox Company is called on to furnish the steel forms to do it. Because they are quicker, cheaper and more accurate than wood forms.

When excavating is to be done or loose bulk material to be rehandled, Blaw-Knox Company is asked to furnish the proper bucket, because it works from whistle to whistle without a waste of time or energy.

When a transmission-line is to be erected, it is carried on Blaw-Knox towers because none has ever failed. And before a high-temperature furnace is put to work, it is equipped with Knox patented water-cooled appliances because they save men and materials, time and expense.

The steady growth, year-in and year-out, of Blaw-Knox Company is the unquestionable answer to the inquiry—*are Blaw-Knox products and service successful?*

BLAW-KNOX COMPANY, Pittsburgh

Offices in Principal Cities — Export Representation

These products are built and trade-marked by Blaw-Knox Company

BLAW STEEL FORMS for all kinds of concrete construction, from sewers to subways, from sidewalks to skyscrapers.

BLAW CLAMSHELL BUCKETS and Automatic Cableway Plants for digging and handling.

FABRICATED STEEL—Manufacturing plants, bridges, crane-runways, trusses, etc.

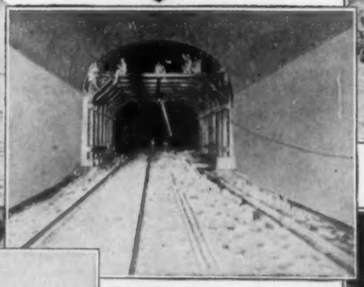
KNOX PATENTED WATER-COOLED APPLIANCES for open-hearth, glass, copper regenerative, and sheet and pair furnaces.

TOWERS for supporting high-tension transmission-lines.

PLATE WORK—Riveted and welded steel plate products of every description.

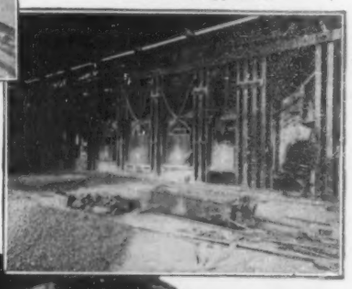
BLAW-KNOX

Blaw Light Wall Forms used in the construction of concrete foundations for houses.



Blaw Steel Forms used on the Diana Tunnel, L. & N. R. R. Train Service maintained.

Steel transmission-tower line built for West Penn Power Co., carrying 130,000 volts.



Open-Hearth Furnaces of Edgewater Steel Co., equipped with Knox Patented Water-Cooled Appliances.

BLAW-KNOX COMPANY

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Testing a new steel with the oxy-acetylene torch to determine its resistant qualities

Steel That Resists the Oxy-Acetylene Torch

THE numerous serious and violent strikes in the country and the red cloud of anarchy that has hovered over the greater part of Europe during the past few months has caused bankers and others interested in safeguarding wealth and valuables, to seek for surer protection in vaults and other repositories. For it is an established fact that the thickest and hardest steel vault or bank door is not even burglar-proof since the development of the oxy-acetylene torch. This was readily demonstrated at a unique test recently conducted in New York City, before a group of bank representatives, architects and vault designers, to illustrate the resisting qualities of a new material.

A section of steel axle six inches in diameter was cut in two in 34 seconds, using a regular cutting burner tip. Then a 1½-inch hole was burned horizontally through a four-inch steel plate in 24 seconds.

Having demonstrated the ease with which steel is cut by the torch, the flame was next brought to bear on the new steel. This material, in the form of a plate, was held between two plates of common steel. Experts with the torch, accustomed to opening in a few moments safes and vaults accidentally closed by thoughtless bank clerks, undertook to get through the small compound plate. A disk about 10 inches in diameter was cut from the outer half-inch steel plate in less than five minutes, exposing the new metal to direct attack. And then the experts were baffled. They changed to a heavier tip. Flarebacks, with loud reports, occurred frequently. For ten minutes no impression was made. The metal did not even show signs of melting. At the end of twenty minutes a slight indentation had been made.

Then the erstwhile confident experts held a consultation and determined to spare neither gas nor implement in an effort to get through at all costs. Torch tips were burned one after the other, until fourteen had been ruined. Wet asbestos was wrapped about the remaining tips. Finally two torches were applied simultaneously and alternated with hammer and chisel. After an hour and forty minutes of desperate effort, the men succeeded in driving through a one-inch diameter hole. About 300 cubic feet of oxygen and 200 cubic feet of acetylene were used for the task.

To burn a hole large enough for a man to go through, it is estimated that it would require two men about two days with about forty tanks of oxygen and ten tanks of acetylene. There are plenty of occasions when the two days might be made available by a Saturday or Monday holiday; but if a gang of burglars were able to transport to the scene of operations any such outfit as this, they would probably find it equally convenient to move the entire bank building from its foundations and take it away with them to crack the safes at their leisure. So it is evident that the new material when used for a lining makes the present-day types of bank vault as nearly burglar proof as human ingenuity can imagine.

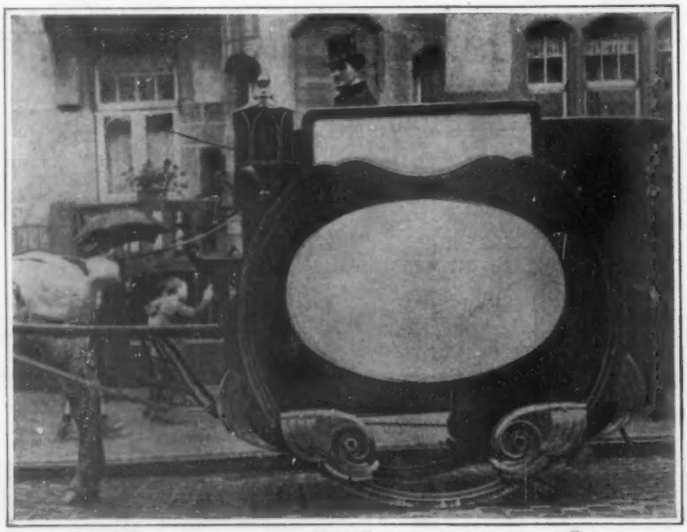
A Safety Razor That Fits in the Vest Pocket

WHILE there has been practically no end to the various types of razors placed on the market, it is a safe guess that the razor recently invented by Chas. Gronbeck of Brooklyn, N. Y., represents a radically new idea. As will be noted in the first of the accompanying illustrations, Mr. Gronbeck's razor is quite small; indeed, it readily fits in one's vest pocket. It is self-contained, there being no loose parts to be misplaced. The razor, which is provided with two short lugs or handles, is held between two fingers in the manner shown, so as to obtain a closer grip than with the long-handled safety razor.

Another invention by Mr. Gronbeck is the safety-razor blade sharpener shown in the second illustration. This little device consists of a leather-covered disk, a shaft, and a blade holder. The blade is firmly held against the stropping leather by a spring that can be regulated to give more or less pressure and is reversed by a trigger or lever. The disk is turned by twisting the fingers holding the shaft. All in all, the little resharpener seems to be as handy as it is efficient.

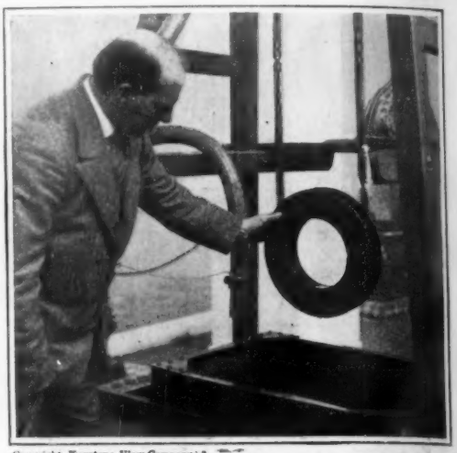
Copyright, Press Illustrating Service

A vest-pocket safety razor and a simple resharpening maching for safety blades



Copyright, Keystone View Co.

Unique German wagon which has plain rims for the vehicle wheels



Copyright, Keystone View Company

Rotating weight and the spring belt of the English pump

Pumping Water With a Spiral Spring Belt

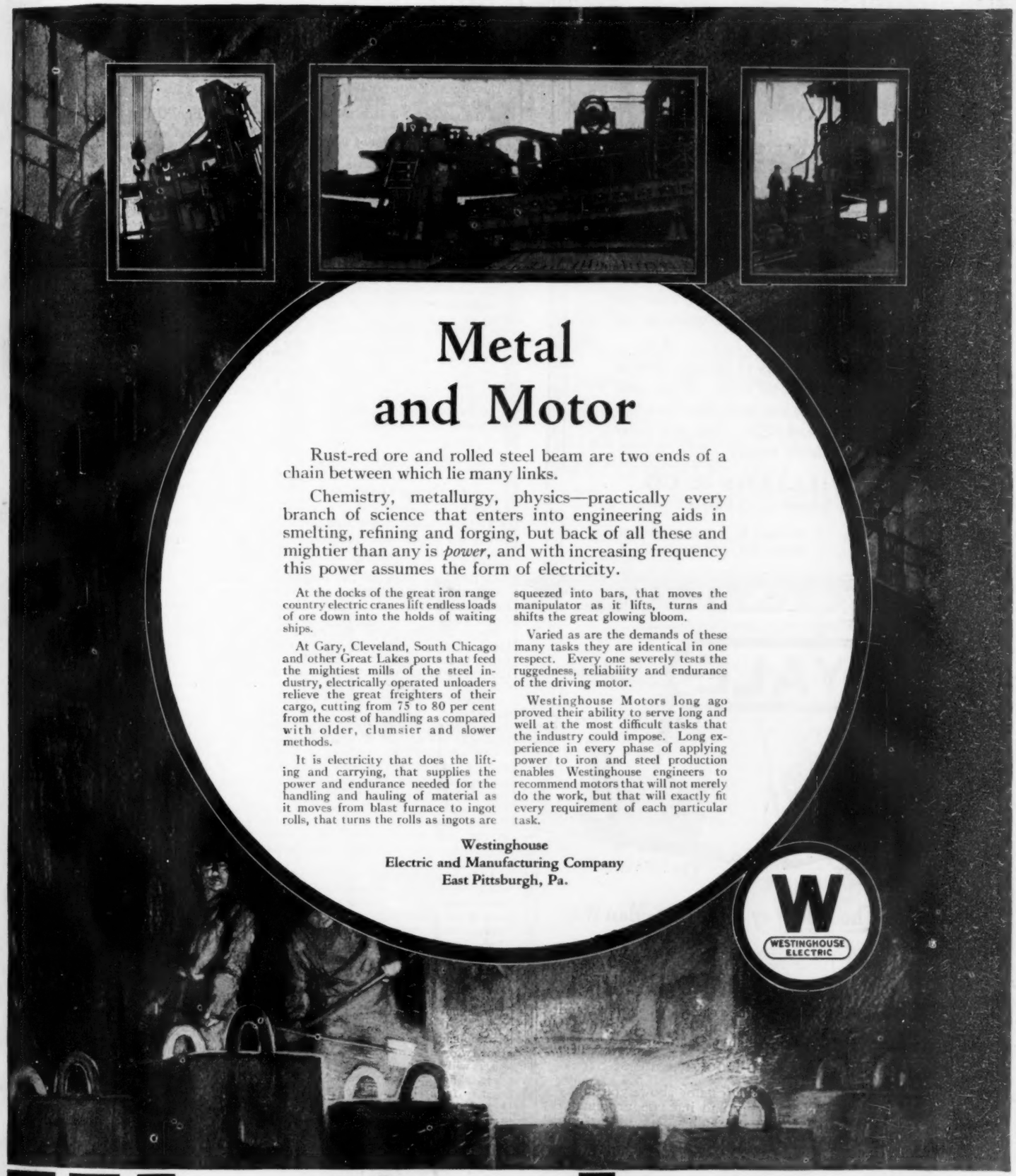
WHAT the eminent British scientists are pleased to call a "mechanical impertinence" has recently made its appearance in England, in the form of a unique pump which works by means of a spiral spring belt. The pump, the bottom member of which is shown in the accompanying illustration, consists simply of a spiral spring belt, a grooved weight which turns with the bottom loop of the belt and holds the latter in place, and a driving crank and pulley for turning the belt. Despite this simple construction the pump is capable of lifting a thousand gallons of water per hour from a depth of 300 feet, even when worked only by hand, according to reports. The coil-like cable is sunk to any depth by the rotating weight shown. Obeying the law of capillary attraction, the water lodges between the turns of the spiral spring and only falls out when it reaches the top of the pump.

A Carriage With Spokeless Wheels

HAVING dropped militarism and war, Germany has now turned its attention to inventing—and with promising results. Of the many strange things now appearing in Germany as a result of the inventive wave that has swept that country as well as most of the world at large, is a carriage equipped with spokeless wheels. This carriage, it will be noted in the accompanying illustration, makes use of two rims in place of wheels. The rims are held in place by small wheels, and may be said to work very much after the fashion of the tank; that is to say, the vehicle rolls along on the rails formed by the rims. It is claimed that this method of mounting carriages possesses various advantages, among them the reduction of friction. At any rate, the novelty of the arrangement is sufficient to make it of some value for advertising purposes, such as is the case in the accompanying illustration.

The "Reliability" Prize

LONDON considers that a great impetus has been given to commercial aviation by the new prize of $50,000 offered by the *Daily Express* for imperial reliability flights. Airships as well as airplanes are included in the competition, the precise terms of which are now being arranged. Peculiar importance is understood to be attached to the flight to India for three reasons: The potential commercial value of India to the British Empire; the delay in sea and cable routes to India; and the established fact that the defense of India's frontiers will rest chiefly in the air.



Metal and Motor

Rust-red ore and rolled steel beam are two ends of a chain between which lie many links.

Chemistry, metallurgy, physics—practically every branch of science that enters into engineering aids in smelting, refining and forging, but back of all these and mightier than any is *power*, and with increasing frequency this power assumes the form of electricity.

At the docks of the great iron range country electric cranes lift endless loads of ore down into the holds of waiting ships.

At Gary, Cleveland, South Chicago and other Great Lakes ports that feed the mightiest mills of the steel industry, electrically operated unloaders relieve the great freighters of their cargo, cutting from 75 to 80 per cent from the cost of handling as compared with older, clumsier and slower methods.

It is electricity that does the lifting and carrying, that supplies the power and endurance needed for the handling and hauling of material as it moves from blast furnace to ingot rolls, that turns the rolls as ingots are squeezed into bars, that moves the manipulator as it lifts, turns and shifts the great glowing bloom.

Varied as are the demands of these many tasks they are identical in one respect. Every one severely tests the ruggedness, reliabiiity and endurance of the driving motor.

Westinghouse Motors long ago proved their ability to serve long and well at the most difficult tasks that the industry could impose. Long experience in every phase of applying power to iron and steel production enables Westinghouse engineers to recommend motors that will not merely do the work, but that will exactly fit every requirement of each particular task.

Westinghouse
Electric and Manufacturing Company
East Pittsburgh, Pa.

W
WESTINGHOUSE ELECTRIC

Westinghouse

ELECTRIC MOTORS AND CONTROLLERS

Williams' Superior Drop-Forgings

IN our efforts to keep the "Superior" in all Williams' Drop-Forgings, we use only the best material, thoroughly tested, and skilled workmanship of the highest order, from the sinking of the dies to the final operation on the completed forging.

After nearly half a century of constant effort to produce only the best, we've an old-fashioned craftsman's pride in the work that bears the Williams' Trade-mark <W>. You will never find it on an inferior forging.

J. H. WILLIAMS & CO.

"The Drop-Forging People"

28 S. Clinton St. Chicago, Ill. | 28 Vulcan St. Buffalo, N. Y. | 28 Richards St. Brooklyn, N.Y.

YALE

The Costly Way — The Yale Way

The Yale Way is the One-Man Way

MANY delays in Shipping and Receiving Departments can be overcome with the installation of a Yale Chain Block and Trolley System.

One man with the Yale Chain Block and trolley accomplishes the handling of loads quicker and safer than a gang of men.

'From Hook-to-Hook-a-Line-of-Steel'

The new Yale 19D catalog shows you many ways to save money and increase production in your plant by using Yale Chain Blocks and Electric Hoists.

Let us send you your copy.

For a factory locking equipment use a Yale Master-Key system.

The Yale & Towne Mfg. Co.

Makers of the Yale Locks

9 East 40th Street New York City

How We Get Ourselves Killed

(Continued from page 549)

should accord the autoist, and the procedure for dodging him. The pessimist might say that the decrease is due to the fact that all the pedestrians who have not been killed have bought them cars in self-defense; but we will hardly take so gloomy a view.

The drowning rate for 1917 is less than for any year since 1910, and far below the average for the decade 1901-1910. Asphyxiation claimed more victims than in the preceding year; mining accidents less than in recent years up to 1913, though somewhat more than for the years up to that date. Vehicles other than automobiles killed less persons than ever before, doubtless for reasons similar to those behind the increase of automobile deaths; street-cars wrought more destruction than for 1916 or 1915, but less than for earlier years.

Perhaps the most discouraging feature of the whole business is the total for machinery accidents. While not impressively large in comparison with other causes, this is a class of accident which is almost always avoidable by the exercise of the most elementary precautions; and it is one against which the safety engineers have launched their heaviest drive. In spite of this, machinery accidents reached in 1917 a level of destruction of human life higher than any ever before attained since records have been kept of these matters. Here is something for the "Safety First" people to ponder.

Fertilizing Oyster Beds

WHEN the soil of your flower beds grows "sour" and the plants fail to thrive, you lime if you are an up-to-date horticulturist. But did you ever hear of liming an oyster bed? It is something that they are doing in the progressive young state of Washington. And the results are just as satisfactory as in the flower beds.

Puget Sound, where the small but highly flavored native oyster is cultivated systematically for the markets of the entire West, was the scene of the experiment with lime and the state fish commissioner, L. H. Darwin of Seattle, has officially announced its success and recommended the adoption of the new system by the commercial oyster growers.

The entire Pacific Coast has a soil lacking in lime. The oyster requires lime to build its shell. Experts of the fish commissioner's staff put two and two together and made the deduction that if the soil of the Pacific coast were lacking in lime, the water of that ocean must also to a certain extent be deficient in that mineral.

A year ago a large quantity of pulverized limestone was purchased by the commission and scattered over the bottom of the state's Oakland Bay oyster reserve. This summer oysters from the limed beds were compared with oysters from adjoining beds that had received no lime. It was found that the oysters from the former beds had made a larger growth, were of a better color and that even a novice could distinguish the difference. It is the judgment of the chemist who had to report upon the experiment that two years from next June the limed beds will show double the amount of oysters, and that they will be superior to oysters from beds in which no lime was placed.

The application of lime to the Puget Sound oyster beds will be easily made since at Olympia, Shelton and other places where the industry flourishes the oyster lands are diked with cement walls separating them from the open Sound, and the benefits of the lime treatment can be localized and obtained at little expense.

Hundreds of carloads of eastern "oyster seed," tiny baby oysters, are planted each year in the oyster beds of the Pacific Coast and thousands of bushels of the transplanted oysters are sent to the market each season. But the transplanted oysters have up to the present time refused to propagate themselves. It is thought barely possible that liming the beds may change this condition. But if it does not Fish Commissioner Darwin is confident that liming the beds will make the transplanted bivalves grow to a larger size and increase the production.

Fuel Oil In Sumatra

IN a general way there is no supply of fuel at Belawan, the port of Medan, available for purchase except on notice of at least two weeks. Under ordinary circumstances vessels can be furnished with oil sufficient to take them to Singapore, which would not require much more than 6 tons. Probably 40 or 50 tons could be given any ship on due notice, and the only supplier of oil, a Dutch concern, would use every effort to supply American oil-burning vessels, calling at Belawan, with sufficient quantity to enable them to proceed either to Singapore or to Batavia. No oil tanks have been erected at Belawan, and oil would, therefore, be loaded from lighters.

For the present or until the harbor works are completed, permitting deep-sea vessels to enter the port, no tanks will be constructed, and not then unless probable business warrants it. It is impossible to give current prices, but it is not likely that these would be much in advance of those obtaining either at Singapore or at Batavia, and the excess, if any, would be due to the lack of proper installations for loading oil into ships.

Better Steel Rails

AN American authority on the manufacture of steel rails made two striking statements in an important paper, "The Manufacture of Steel Rails," before the fall meeting in September of the American Institute of Mining and Metallurgical Engineers. The subject of better rails has been discussed from many angles but the two recommendations or prophecies which Robert W. Hunt made came as a surprise to many and struck a responsive chord in the minds of many metallurgists.

Starting with the statement that to secure sound rails it is of supreme importance to have sound ingots, Mr. Hunt went so far as to say that while he was not at this time prepared to incorporate hot-top ingots in rail specifications, the time is near when it will be entirely practical to do so. Also while this may involve a somewhat greater first cost, it will be partly offset by a saving in scrap. It was found necessary during the war to make this outlay for hot-top ingots in order to make proper start to destroy human life. Is this matter not all the more justifiable in the case of rails when human safety so much depends on sound rails?

The second recommendation or prophecy of Mr. Hunt had to do with the use of pre-melted manganese alloys in steel-making. Calling attention to the fact that the threatened scarcity of manganese during the war led to the adoption of premelting ferromanganese and spiegeleisen which resulted in marked economy, the speaker stated that from a metallurgical point of view the results had also been very satisfactory, and rail specifications should insist on this practice.

Hot-tops for ingots are as necessary to really sound steel as adequate sink heads for castings are vital to sound steel castings. It has been a surprise to many that the hot-top ingot has not been more generally adopted in American steel practice. In most new plants, particularly electric steel ingot practice, they are generally used.

As to premelting manganese iron alloys, both British and German experience during the war demonstrated that melting ferromanganese in electric furnaces re-

sults in a saving of about 30 per cent manganese and in other decided advantages.

Another interesting development in the steel rail problem is the serious consideration being given to the heat-treatment of rails by electricity. Experiments along these lines are said to have revealed striking results, so much that the electrical heat treatment of steel rails in a commercial scale is being developed by one progressive American company.

It is hoped that the recommendations of Captain Hunt may be realized not only as to steel rails but also as to other products. There is large room for improvement despite the fact that there are serious obstacles as between maker and user. Quality steel in quantity can be measurably achieved by these metallurgical factors.

Radio Fog Signalling

IN coöperation with the Bureau of Lighthouses, experiments are being carried on by the Bureau of Standards to establish a radio fog signaling system. Such a system, when perfected, will give to the navigator a reliable signal under any conditions of fog and make him independent of the lighthouse lamp. The principal object to be sought is the sending out of a radio signal automatically from a lighthouse and the reception of this signal upon a ship by a very simple radio direction finder. If a number of important lighthouses on the Atlantic coast are equipped with this system, the safety of navigation will be greatly advanced. In connection with these experiments, radio transmitting apparatus is being placed at three lighthouses in Chesapeake Bay and the radio receiving apparatus and direction finder installed on a lighthouse tender. Three lighthouses are used, so as to give comparative information on different types of modern transmitting equipment and to determine which is the best suited for this work. The apparatus is of special types developed by the bureau as a result of some of its researches on radio problems during the war.

Can Fish Hear?

THIS much disputed question seems at last to have been settled in the affirmative, due to the recent researches made by Dr. Anton Krause. As there is no portion having convolutions in the auditory organs of fish, it was assumed that fish had no hearing powers. It has, however, been demonstrated that not the receiving apparatus, but the auditory nerve, which can spread out in all directions close under the surface of the body is the chief essential for hearing purposes. Whereas the removal of the inner ear of fish had apparently no effect, they were no longer on the contrary affected by waves of sound as soon as the auditory nerve had been cut through.

That fish can hear has been shown by experiments made with no less than 35 different species. Former attempts made to settle the question have all led to very confusing results. Maier for instance in 1909 observed in a very shy specimen of the silurus glanis or sheath-fish, that it disappeared like a flash of lightning when he whistled, and this led him to repeat the test with other fish and with the same result. Dr. Benjamin (of Utrecht) also observed that fish would quickly disappear behind stones or plants upon stamping on the floor, or knocking at the walls of the aquarium; whistling, shouting and singing, however, he states had no effect whatsoever. Dr. Krause experimented with a silurus glanis of about 12 inches long. Conversation held in an ordinary tone of voice at a distance of 3 or 4 yards did not affect the fish at all; movements of people and walking over the floor in an ordinary manner also did not disturb the specimen. Stamping, however, caused the fish to dart away at

Yes, We Could—But We Won't

We could build Wisconsin Motors cheaper—build them so that their initial price would be somewhat lower than it is. But that is absolutely against our policy, and always will be.

It would mean the elimination of the careful adjusting, fitting, running-in, testing and inspecting—high-priced workmanship that gives the Wisconsin its perfect performance.

Why Wisconsin Bearings Give Super-Service

The seating of each bearing shell in the case receives as careful workmanship as the bearing itself. After it is machined to shape with a flycutter, a reamer and scrapers are used to perfect it. Bearing itself is reamed and finally brought to 100% bearing contact in a power lapping machine.

Wisconsin CONSISTENT

engines leave the factory ***ready to run***—working parts fitted to the thousandth part of an inch. Every Wisconsin is adjusted and tested, torn down, re-assembled, re-fitted and re-tested until it is operation-perfect—capable of running for months without attention.

Such work costs more—but costs less in the end, for it gives the manufacturer a motor ***ready to install,*** the dealer a truck or passenger car whose engine does not eat its own profit up in costly "service" and it relieves ***you*** of the annoyance and expense of repairs and continual adjustments.

If there is a Wisconsin under the hood you can buy safely.

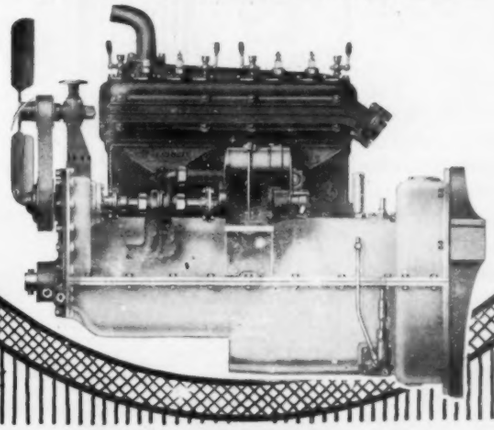
Specifications and booklet, "Honors Wisconsin Has Won," on request.

WISCONSIN MOTOR MFG. CO.

STATION A, DEPT. 352 MILWAUKEE, WIS.

Distributors:
New York Branch: T. M. FENNER, 21 Park Row, Factory Rep.
MARINE EQUIPMENT & SUPPLY CO., 610 Arch Street, Philadelphia, Pa.

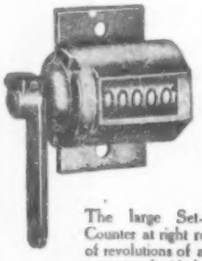
Pacific Coast Distributor:
EARL P. COOPER CO., 1310 So. Los Angeles Street, Los Angeles, Cal.



Get Nearer Capacity

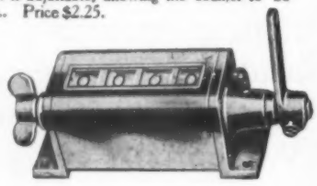
Most machines have an unworked capacity that could cut unit-cost of your product. But getting the output somewhere near that capacity requires a record of *results* and check-up with the *possibilities*—both indicated by

Veeder
COUNTERS



The Number 14 Ratchet Counter at the left registers one for each throw of the lever, recording number of operations of your machine. Supplied with outside stops which regulate the throw of the lever, and having return spring action which automatically returns lever into position for the next count. The lever is adjustable, allowing the counter to be used at any angle.. Price $2.25.

The large Set-Back Revolution Counter at right registers the number of revolutions of a shaft, where these correspond with the operations of your machine. Set back to zero by turning knob, and supplied with from four to ten figure-wheels, as required. Price, with four figure-wheels, $9.00 (List)



You'll have your own special uses for Veeder Counters —and whatever the uses, you'll find suitable counters in the Veeder booklet. Write—

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

The Original COPPER STEEL

bears this *special mark* added below regular brands:

WHEN you specify Keystone—you are specifying for satisfaction. The copper steel alloy gives added resistance to rust and unequaled service. Actual time and weather have demonstrated the superiority of this material for all uses where substantial wear and durability are important factors.

Whether you are a large user of sheet and tin mill products, or require only a new metal roof, or the replacement of some exposed sheet metal work, you should know the advantages of Keystone Copper Steel Sheets and Tin Plate. Shall we send *Facts* booklet?

Apollo

Galvanized Roofing and Siding Products, as formed from APOLLO-KEYSTONE Copper Steel Galvanized Sheets, give unequaled service. Keystone quality is also supplied in Black Sheets, Roofing Tin Plates, etc. Demand this material for Roofing, Siding, Cornices, Spouting, Gutters, Cisterns, Culverts, Tanks, Flumes, and all exposed sheet metal work. This Company manufactures Sheet and Tin Mill Products of every description and for every known purpose.

AMERICAN SHEET AND TIN PLATE COMPANY, General Offices: Frick Building, Pittsburgh, Pa.

once although the aquarium was protected against vibrations by means of felting. A shrill whistle had the same effect although, upon whistling quietly or knocking at a distance of about two meters, the specimen remained motionless. On repeating these experiments regularly, the fish gradually ceased to react regularly to these tests; for instance on the 12th day when loud whistling and knocking were commenced the fish only moved three times in eight separate tests. Krause assumes from this that the silurus glanis hears loud noises, but finally becomes accustomed to them.—*A. H. J. Keane.*

The Flying Mechanism of Flying Fish

THE rapidity with which so-called flying fish dart through the air is imparted to their bodies by the vigorous swimming motion which they make in the water. Since the tail-fin is formed unsymmetrically the axis of the body assumes a direction which slants forward and upward, so that eventually the animal passes automatically from the water to the air. Thereupon the large pectoral and abdominal fins unfold and serve as lifting surfaces like the surfaces of a kite. The feeble muscular equipment of the fins is not suitable either by its mass or its arrangement to make possible any active "wing-beat" of the fins in the air, but serves only for the spreading, stretching and folding of the fins. The various kinds of motions observed in these muscles might be termed passive. This subject has been investigated recently by a German scientist named Ahlborn, a report of whose work appeared in a comparatively recent number (1916) of the *Zeitschrift fuer Wiss. Zoologie.* Ahlborn states that the flight is maintained solely by the previously acquired energy obtained in the water and comes to an end when this energy is exhausted by the resistance of the air. A writer in *Die Naturwissenschaften* remarks, however, that this statement needs to be completed saying: "When the upper surface of the water is perfectly calm and the air above it is free from rotatory movements the flight is actually simply such an 'arrow-flight' as Ahlborn describes. But the disturbance of the air above water in motion when there are ascending air currents upon the slopes of the wave may serve as an external source of energy and transform the arrow-flight into a hovering flight." In his opinion it is only in this way that the fact can be explained that these fishes are able to glide over a distance of from 100 to 120 meters or even, at times, as much as 450 meters although their height above the surface of the water is at no time more than about one meter. He observes that no obliquely-moving plane surface is known to us, which has a ratio of descent of 1:100 or even of 1:450. The fish employs the same energy which is made use of by the albatross; moreover, because of physiological matabolism it may be deduced that in sailing above the waves the fish finds a source of energy in the vertical components of the motions of the air enabling it to make a continued flight.

Peat Fuel For Locomotives

PEAT powder is now being successfully used in Sweden as a substitute for coal for the direct firing of locomotives. The Swedish Government has now erected a peat winning and powdering mills at Hästhegen Moor, from which about 20,000 tons peat powder will be secured from every 220,000 cubic meters of peat. The peat is first of all dried till it only contains about 40 per cent of water; it is then crushed and again dried in an oven until the content of water has been reduced to 12 or 15 per cent. It is said that with 1.5 kilograms peat powder the same amount of steam can be generated as with 1 kilogram coal of 7,000 calories.

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

SCIENTIFIC AMERICAN
contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

MUNN & CO., SOLICITORS OF PATENTS
626 Woolworth Bldg., NEW YORK and 625 F Street, WASHINGTON, D. C.
801 Tower Bldg., CHICAGO, ILL.

Annual Subscription Rates
Scientific American Publications

Scientific American (established 1845) one year $5.00
Scientific American Supplement (established 1876) one year 5.00

Postage prepaid in United States and possessions, Mexico, Cuba and Panama.

Foreign Postage

Scientific American $1.50 per year additional.
Scientific American Supplement $1.00 per year additional.

Canadian Postage

Scientific American 75c per year additional.
Scientific American Supplement 50c per year additional.

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check

Classified Advertisements

Advertising in this column is $1.00 a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

BUSINESS OPPORTUNITIES

SUBSTANTIAL Manufacturing Corporation wants capable men to establish branch and manage salesmen. $300 to $1500 necessary. Will allow expenses to Baltimore as explained. Address, Treasurer, 416 N. Howard St., Baltimore Md.

FOR SALE

PATENT rights on Window Screen Hinge. A household necessity with great possibilities. Full descriptive information and particulars on request. J. B. Bradley, 328—8th Street, Miami, Florida.

DUPLICATING DEVICES

"MODERN" Duplicator—A business getter. $1.50 up. 50 to 75 copies from pen, pencil, typewriter; no glue or gelatine. 40,000 firms use it. 30 days trial. You need one. Booklet free. H. S. Durkin, Reeves & Co., Pittsburgh, Pa.

EUREKA SWITCHBOARDS

EUREKA Switchboards are Standard for High-Voltage Currents, Stations, Powerhouses, Send Blueprints for quotations. The Eureka Marble and Tile Works Company, 179 Maple Street, Columbus, Ohio.

LEARN WATCHWORK JEWELRY WORK AND ENGRAVING

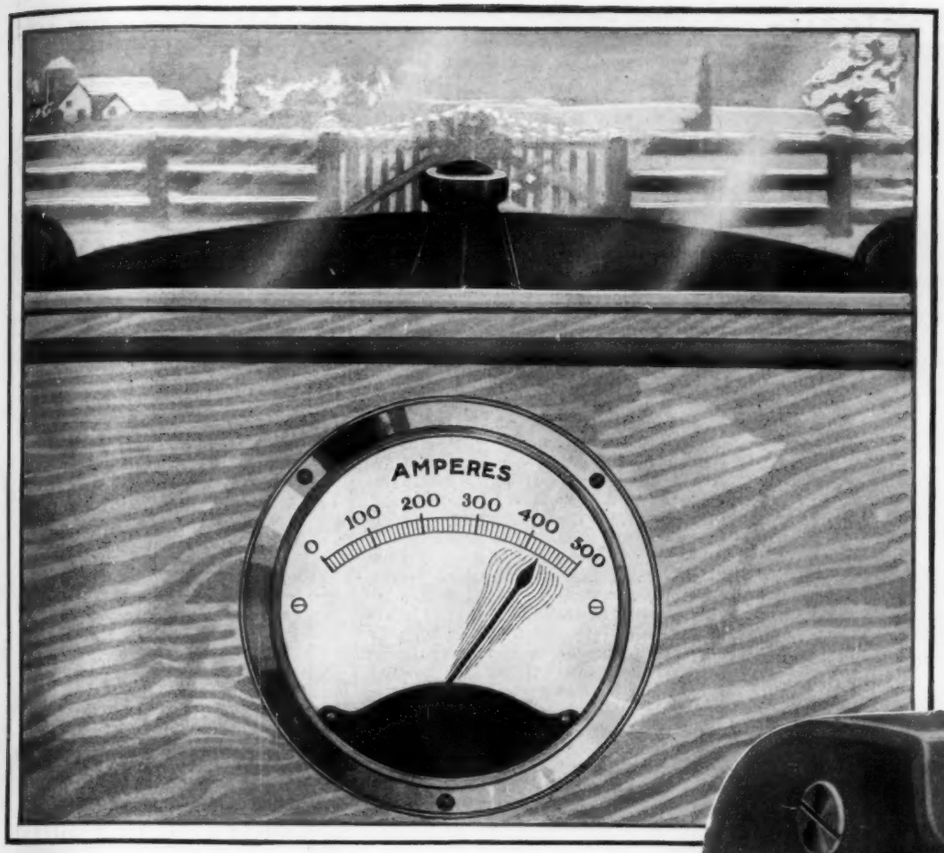
A fine trade commanding a good salary and your services always in demand or you can start in business for yourself. At

BRADLEY INSTITUTE
The greatest school for watchmakers in the world. Address Horological Department, Peoria, Ill., for catalogue of information. Also teach Optics and Instrument Repair.

THE MIDGET SLIDE RULE

will instantly add, subtract, multiply, divide, solve proportion, give any root or power, Logarithms, sines, Tangents, Cosines and Cotangents. Made of metal. Size 4 ins. Price, with 16-page instruction Book, $1.00. Your money back if not satisfied. Send for our catalog of slide rule. All types from 50c to $25. Instructions in Logarithms and Trigonometry free with every catalogue.
Gilson Slide Rule Co., Niles, Mich.

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 033 Bogue Building, Indianapolis

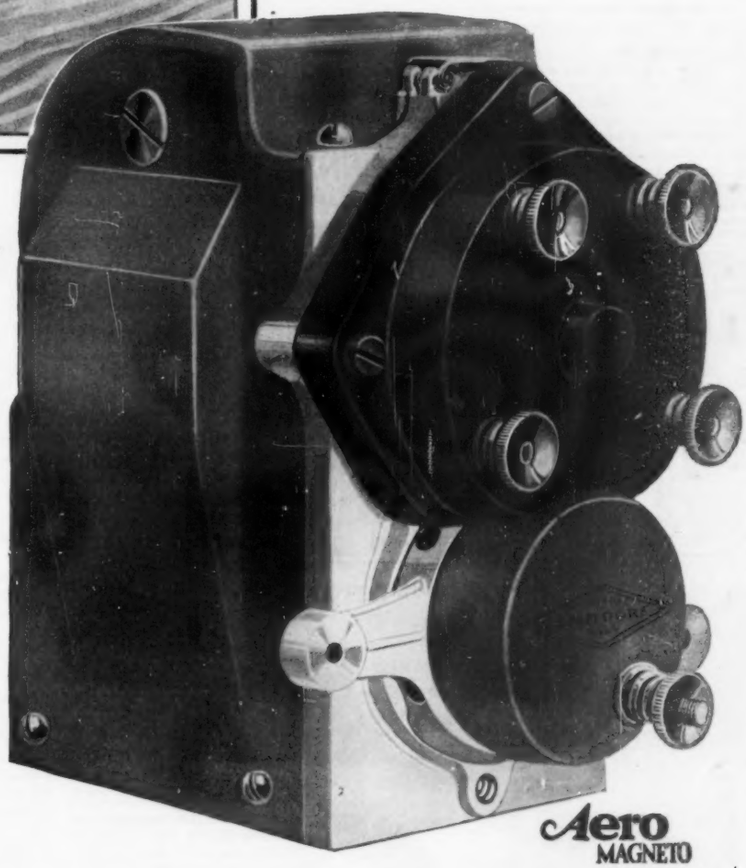


In cold weather-

with the battery discharging as high as five hundred amperes while turning over the starter, very little juice is left for an ignition system.

Gasoline will not vaporize rapidly in a cold engine and a fat hot spark is needed to ignite raw gas.

The Splitdorf Magneto, which generates its own current, does not depend on a battery. It is an entirely independent ignition system. The same hot spark is delivered at all times and under all conditions.



SPLITDORF

Electrical Co., Newark, N.J.

Sumter Division, 1466 Michigan Ave. Chicago

TRADE SPLITDORF MARK

Manufacturers of AERO, SUMTER and DIXIE Magnetos, Oscillating Magnetos and Impulse Starters

The BETTER Lighted Factory~

Shows MORE PROFITS!

Two ways to obtain more light and more production:
Use more Electric Lights or Paint with Cemcoat

Cemcoat will do the work of the expensive electric lights at no cost, except the initial investment.
Cemcoated walls are reflectors which send the light into every corner.

Cemcoat

is the tile-like, light-reflecting, washable wall coating. It is as easily brushed on as paint and combines the best qualities of ordinary paint and high-priced enamel without the faults of either.
Without obligation, one of our experts will inspect your plant and show you how your factory can be made better lighted and more profitable, and submit estimate of costs.

SONNEBORN PRODUCTS

Lapidolith makes old or new concrete floors dustproof and wearproof by chemical action. Just flush it on. Used for years everywhere.

Lignophol, the modern wood hardener gives life to old or new wooden floors. Lignopholed floors last longer, are dustless, smooth and sanitary and present a pleasing, decorative surface.

Cemcoat is furnished in gloss or flat, white and colors for either interior or exterior walls.

Write for details of how one manufacturer increased production 17 by increased light. Free literature, testimonials and color card.

L. SONNEBORN SONS, Inc.
DEPT. 264 PEARL STREET, NEW YORK

One Socket Two Uses

For using light and appliance at the same time
BENJAMIN CONVERTIBLE PLUG
3 for $1.50 OR $1.25 EACH
At Your Dealer's
gives single socket two outlets.
BENJAMIN ELECTRIC MFG. CO.
Chicago New York San Francisco

ECONOMY renewable FUSES

insure maximum safety and minimum cost in safeguarding electrical circuits against the fire and accident hazards of overloads and short circuits. An inexpensive "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency. The Economy is a pioneer renewable fuse. As compared with the use of one-time fuses, it cuts annual fuse maintenance costs approximately 80 per cent.

ECONOMY FUSE & MFG. CO.
Elevate and Orleans Sts. CHICAGO, U. S. A.
Sole manufacturers of "ARKLESS", the Non-Renewable Fuse with the 100% Guaranteed Indicator.
Economy Fuses are also made in Canada at Montreal

Production. Conservation.

Those are the two urgent demands of the day. They are vitally essential during this period of post-war readjustment.

The New Stromberg Carburetor meets both—to the fullest extent. On any car—under any condition—it increases production of power, of speed and of mileage.

It conserves fuel and fuel costs. Effects the greatest of economy through development of greatest fuel *force*, insuring a decided improvement in engine efficiency—an important increase in driving power and radical reduction in travel costs. Write for literature. State name, year and model of your machine.

Stromberg Motor Devices Co., Dept. 1216, 64 E. 25th St., Chicago

New STROMBERG Does it!
CARBURETOR

Utilizing the Earth's Internal Heat

IT has long been recognized that if we could only bore deep enough into the crust of the earth we could tap inexhaustible sources of heat; and possibly when we have got out all the extractable coal and our coal pits appear no longer to have any practical value, we shall use the bottom of them as platforms from which to sink artesian wells deep enough into the earth to tap some of its internal heat. There are places where this could probably be done now with commercial success. On the other hand, there are places also where the internal fires come very near to the surface, and, indeed, break through. One of these regions is in Tuscany, in Italy. Here, at Larderello, Monte-Cerboli, and other places, the initial stages in the production of borax, of which the crude material exists in enormous quantities in the neighborhood, have for years been carried out by the aid of steam obtained from the interior of the earth through natural outlets which the Italians call soffioni. An enterprising Italian, Prince Ginori-Conti, has recently gone a stage further, and has employed this natural steam for driving engines. It has taken him some years to develop his project. First he began with a 40-horse-power engine; then installed a 300-horse-power turbine alternator; while today, at Larderello, a central station of 16,000 horse-power is running continuously and supplying electric current to Florence, Leghorn and other towns, the heat being obtained from the natural jets of steam issuing from the earth, which the Prince has shut in and collected and uses as he requires. The pressure which these jets give is as much as 100 pounds to the square inch.

Those who have followed the proceedings of the British Association at its meeting at Bournemouth will have noted that Sir Charles Parsons, the President of the year, in his opening address, also referred to this possibility. Sir Charles Parsons, reviving an old proposition of his own, suggests the sinking of a borehole to a depth of 12 miles through the crust of the earth, and points out that the cost, even at present-day prices, would not exceed the amount which this country alone spent per day on the war for a lengthy period, while the information which we might gain from such a boring would be invaluable. Unfortunately the time required to sink this shaft, according to Sir Charles Parsons' estimate, is 85 years; and it is hardly likely, therefore, that the present generation would agree to provide the necessary funds. A much less expensive project, however, would probably provide a new source of power in more than one region of the earth even in our time.

Transmitting Speech by Light

THE soirées of the Royal Society of London which were discontinued during the war, were renewed last spring. The first Ladies' Night was held at Burlington House in June and among the interesting things exhibited was the novel apparatus invented by Dr. A. O. Rankine of University College, for transmitting speech by light. The transmitter was mounted at one end of a series of large rooms, the receiver being at the other end. The transmitter is a combination of a diaphragm and mirror device which causes the intensity of a ray of sunlight or of a beam from an arc light to fluctuate in accordance with the vibrations of the voice. Part of the beam of light is concentrated by means of a lens upon a selenium cell in the receiver, this cell being in series with a telephone to which the listener applies his ear. Transmission of speech has been successfully effected over a distance of more than a mile. The interposition of the screen entirely cuts off the sound.—*Engineering* (London).

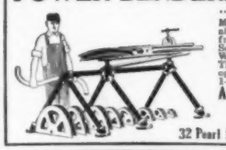
The "BARNES" Positive Feed
Upright Drills

10 to 50-inch Swing
Send for Drill Catalogue
W. F. & Jno. Barnes Co.
Established 1872
1999 Ruby Street Rockford, Illinois

SOUTH BEND LATHES
Established in 1906 Over 21,000 South Bend Lathes in use

For the Machine and Repair Shop
LOW IN PRICE
12 in. to 24 in. swing
Straight or Gap Beds
How to Run a Lathe
A 80 page book
For 10c Postpaid
Coin or Stamps
Send for free catalog giving prices on entire line
South Bend Lathe Works
431 Madison St.,
South Bend, Ind.

POWER BENDERS THREE NEW MODELS



"Wonder" Pipe Benders Machines (pat.) electrically operated to bend from 1 inch to 18 inches. Send for printed matter. We also manufacture TEN other sizes, hand operated to bend from 1-8 inch to 3 inches.
American Pipe Bending Machine Co.
Manufacturers
32 Pearl St., Boston, Mass. U.S.A.

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES in Canada. We also carry fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.
For anything you want in Asbestos, turn to
KEASBEY & MATTISON COMPANY
DEPT. S-1
AMBLER, PENNA, U. S. A.
Owners of the world's largest Asbestos Mines

NOVELTIES & PATENTED ARTICLES
MANUFACTURED BY CONTRACT. PUNCHING DIES.
LIGHT AUTOMOBILE STAMPINGS
E. KONIGSLOW STAMPING & TOOL WORKS, CLEVELAND, O.

THE No. 51 UNIVERSAL WOOD WORKER is the most wonderful wood working machine you have ever seen. 26" band saw, 8" jointer, reversible single spindleshaper, saw table and borer all in one. Ask for special catalog describing it. Also ask for catalog of band saws, saw tables, jointers, variety wood workers, planers, swing saws, disk grinders and borers.

THE CRESCENT MACHINE CO.
230 Main St., Leetonia, Ohio, U.S.A.

THE BRIDGEPORT CHAIN CO.
Specialists in Small Wire Shapes and Flat Stampings
BRIDGEPORT, CONNECTICUT

INVENTORS Give us only your ideas—we will develop them. We are experts in model and experimental work and developing inventions. Designing and building special labor saving machinery a specialty.
Elk Mfg. Co., 1926 Broadway, New York

SOLVINE BOILER PRESERVER
Warranted, without reserve, to remove boiler scale prevent pitting and scale formation.
Pamphlet on request. Money back guarantee.
SOLVINE MFG. CO. Jersey City, N. J.

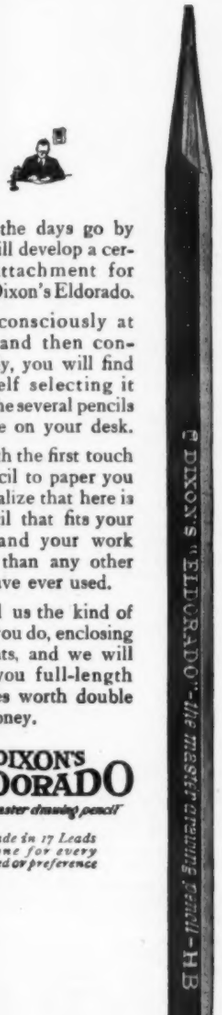
THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES
BRIDGEPORT CONN.

INSYDE TYRES Inner Armor
for Auto Tires. Double mileage, prevent blowouts and punctures. Easily applied in any tire. Thousands sold. Details free. Agents wanted.
Amer. Accessories Co., Dept. 5 Cincinnati

Printing Cheap
Cards, circulars, labels, book, paper. Press $15. Larger $25 Job press $100. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. THE PRESS CO., D-22, Meriden, Conn.

KNOW COSTS ACCOUNTANCY
Be a Cost Expert. Earn $5,000 to $10,000 yearly
C.P.A's teach you thoroughly in a few months in our New Home study system-Low Cost-FREE Book
International Accountants Society, Dept. 4138 2626 S. Michigan Ave. Chicago

A 96-PAGE CATALOGUE
OF
Scientific and Technical Books
Listing 2500 titles on 500 subjects, may be secured by addressing
SCIENTIFIC AMERICAN PUBLISHING CO.
Woolworth Bldg., New York



As the days go by you will develop a certain attachment for your Dixon's Eldorado.

Unconsciously at first, and then consciously, you will find yourself selecting it from the several pencils that lie on your desk.

With the first touch of pencil to paper you will realize that here is a pencil that fits your hand and your work better than any other you have ever used.

Tell us the kind of work you do, enclosing 15 cents, and we will mail you full-length samples worth double the money.

DIXON'S ELDORADO
The master drawing pencil

Made in 17 Leads —one for every need or preference

JOSEPH DIXON CRUCIBLE CO.
Pencil Dept. 121-J, Jersey City, N. J.

Canadian Distributors
A. R. MacDougall & Co., Ltd., Toronto

5A MOTOR ROBES

Learn Tree Surgery

The one real profession that is not overcrowded

Healthful, fascinating outdoor work on America's richest country estates; travel with carfare paid; good money at the start and a big chance for advancement; a dignified and scientific profession that commands the respect of everybody—this is the opportunity offered you as a Davey Tree Surgeon. Write for details of our plan to train you—at home in your spare time or at our headquarters in Kent—and give you a *guaranteed position* in our own organization, the largest and most successful of its kind in the world. Unmarried men, ages 18 to 32 preferred. The Davey Tree Expert Co., Inc., 80 Elm Street, Kent, Ohio.

Cerium in the Iron Foundry

A NEW alloy of a rare element or metal with iron has made its appearance for which many advantages are claimed for its use in making cast iron and possibly steel. It is ferro-cerium or an alloy of cerium and similar rare metals with iron. The use of cerium metal as a deoxidizer and scavenger for gray cast iron has recently been studied and some interesting results have been obtained.

The commercial source of cerium metal is monazite sand. From this the cerium content is converted into anhydrous chloride, and this fused salt electrolyzed to obtain the metal: The metal here obtained is commercially known as "cerium" or "mix metal," and has a content of 96 to 99 per cent of rare earth metals, of which 50 to 70 per cent is cerium, the remainder being lanthanum and neodymium with small amounts of other rare earth metals such as praseodymium, samarium, yttrium, etc. The metal also contains 1 to 3 per cent iron and small amounts of carbon and silicon.

For use with cast iron the metal is alloyed with 30 per cent of iron which gives a brittle alloy with a melting point well within that of cast iron and with a specific gravity approximately the same as that of cast iron. This alloy is quite stable in dry air and tarnishes only slowly in moist air. At high temperatures it is very active chemically, being an extremely powerful deoxidizer with a very high heat of oxidation. Misch metal will reduce silica, making silicon.

A series of foundry tests have been carried out in which the cerium-iron alloy was added to the ladle in varying amounts from 0.01 to ½ per cent cerium. Test bars were cast and studied. Addition of the cerium metal materially lowers the amount of combined carbon without increasing the total carbon. The structure of the cerium-treated bars as compared with the non-treated ones showed a more uniform distribution of free graphite and a smaller depth of chill. The addition of more than 0.05 per cent cerium increased the transverse strength, tensile strength and the deflection. There was no cerium remaining in the iron even when as much as ½ per cent had been added to the ladle. The addition of the cerium to the ladle seemed to increase the temperature of the melt and resulted in an appreciable amount of slag collecting on the surface. There was no difficulty in getting the alloy to mix intimately with the iron as the specific gravities of the two are practically identical.

A further series of tests carried out by Dr. Richard Moldenke have confirmed the results of the earlier tests. The practical results of the addition of cerium are that the castings have greater machinability and soundness and are more free from casting strain when the cerium metal is added. Generally the addition of about .02 per cent of cerium in the form of the ferro-alloy will produce the above results. In one case where a customer had been rejecting about 30 per cent of castings due to porosity, bad chill spots, etc., the addition of 0.02 per cent of cerium metal in the ladle reduced this loss to under 1 per cent. Another manufacturer uses cerium metal in certain of his castings as the result of which an annealing operation is done away with previous to machining.

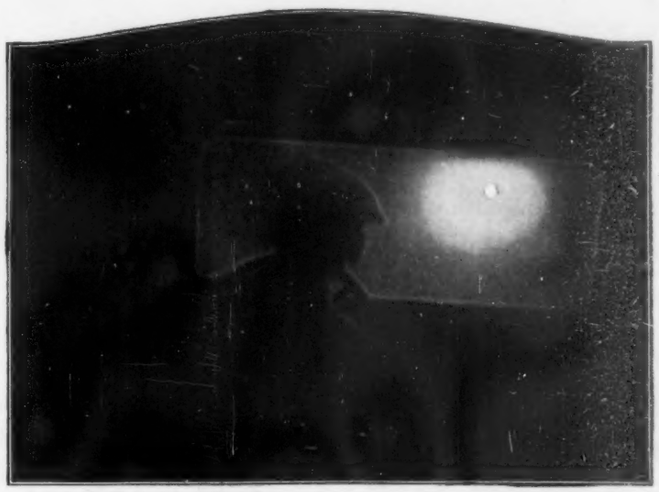
In addition to the use of cerium in cast iron some preliminary experiments have been carried out in its use in steel with results which indicate that this metal may be expected to take its place as a valuable metal for purifying steel.

Is Nitrogen an Element?

THE discovery of Becquerel in 1896 of the spontaneous emission of radiations by uranium and the discovery of radio-activity resulted in the discovery, as we know, that the atoms of radio-active

MAZDA

"Not the name of a thing, but the mark of a service"



What is it?

Motorcycle or car? If it is a car, which lamp is out—left or right?

Lamp-unreliability is both *dangerous* and unnecessary. The known high standards of MAZDA Service are sufficient to make the cautious and considerate insist on having MAZDA Lamps—*lamps marked MAZDA.*

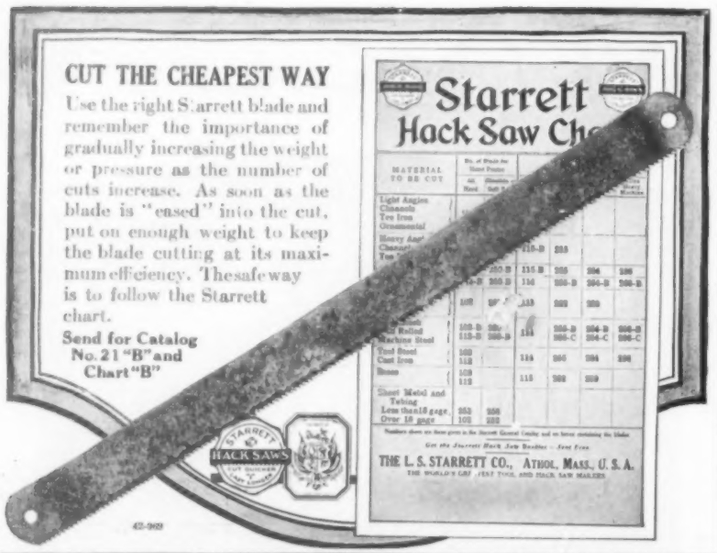
MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this service.

MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady, N. Y. The mark MAZDA can appear only on lamps which meet the standards of MAZDA Service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.

GE

473-3

RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY


CUT THE CHEAPEST WAY
Use the right Starrett blade and remember the importance of gradually increasing the weight or pressure as the number of cuts increase. As soon as the blade is "eased" into the cut, put on enough weight to keep the blade cutting at its maximum efficiency. The safe way is to follow the Starrett chart.
Send for Catalog No. 21 "B" and Chart "B"
Starrett Hack Saw Ch
THE L. S. STARRETT CO., ATHOL, MASS., U. S. A.

SAVE 1/2

Your "Gas" and ALL Your Trouble

Evidence!—"I showed 32.3 miles on Maxwell demonstration with U. & J. Carburetor—32½ miles per gallon with Ford."

M. E. Scott, Berry, Ia.

U. & J. CARBURETOR

Doubles Mileage — Guaranteed to start car in Zero weather—No Priming. Entirely NEW principle—not a moving part—Simple. Has the Pep and Power. 50,000 delighted users. Now ready for Ford, Dodge, Maxwell and Overland.

15-DAY FREE TRIAL
Money-back Guarantee

DEALERS—Service Stations, Salesmen: The "U. & J." sells on demonstration—installed in thirty minutes—some good open territory.

U. & J. FORD TIMER will last as long as the car. Price $1.75.

U. & J. CARBURETOR CO.
Dept 209—607 W. Jackson Blvd., CHICAGO

THE 100% WIRELESS MAGAZINE

The magic of wireless is calling. You can now hear wireless phone talk and receive messages from Europe. All about these and hundreds of other important things of interest to the amateur are in the Radio Amateur News. The greatest and biggest wireless magazine in U. S. Over 100 illustrations, 56 big pages and over 60 articles.

Nothing but wireless One copy will convince you.

On all newsstands 15c, $1.50 a year, Canada and Foreign $2.00. Send for free sample.

Radio Amateur News, 237 Fulton Street, New York City

Send Your Name and We'll Send You a Lachnite

DON'T send a penny. Just send your name and say: "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.

Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.

Harold Lachman Co., 12 N. Michigan Av., Dept. T2429 Chicago

WELL DRILLING PAYS WELL

Own a machine of your own. Cash or easy terms. Many styles and sizes for all purposes Write for Circular.

WILLIAMS BROS., 434 W. State St., Ithaca, N.Y.

EXPRESS SERVICE
MASON'S NEW PAT. WHIP HOIST

Comparative cost 40 foot lift:
By elevator—5 men, 50 bales of wool per hour
By Mason's Whip—3 men, 90 bales of wool per hour
One rope hoists, lowers and holds the load

Manufactured by VOLNEY W. MASON & CO., Inc. Providence, R. I., U. S. A.

Automobile Welding with the Oxy-Acetylene Flame

By M. KEITH DUNHAM

167 Pages Price $1.25 By mail $1.30 *Fully Illustrated*

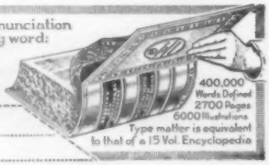
This is the only complete book on the "why" and "how" of Welding with the Oxy-Acetylene Flame, and from its pages one can gain information, so that he can weld anything that comes along.

No one can afford to be without this concise book, as it first explains the apparatus to be used, and then covers in detail the actual welding of all automobile parts. The welding of aluminum, cast iron, steel, copper, brass and malleable iron are clearly explained, as well as the proper way to burn the carbon out of the combustion head of the motor.

SCIENTIFIC AMERICAN PUBLISHING CO.
233 Broadway, Woolworth Building New York

WEBSTER'S NEW INTERNATIONAL DICTIONARY
G. & C. MERRIAM CO., SPRINGFIELD, MASS. REGULAR AND INDIA-PAPER EDITIONS

Whatever your question:—be it the pronunciation of Bolshevik, the spelling of a puzzling word: the location of Zeebrugge, the meaning of blighty, ace, tank, etc., this Supreme Authority contains an accurate, final answer.



Type matter is equivalent to that of a 15 Vol. Encyclopedia

Please send me specimen pages and FREE POCKET MAPS For Scientific Am.

NAME.....

ADDRESS.....

bodies are not immutable units of matter as had been previously supposed. In radio-active bodies the atom is undergoing continual change by reason of the expulsion of particles. The accepted theory is that an atom consists of a body composed of a central nucleus surrounded by particles, somewhat after the manner of our own sun as surrounded by its planets, this system being held together by an attractive force which is usually sufficient to keep the elements united; but in radium and other radio-active bodies this attraction is supposed to be too feeble, so that *alpha* particles are continually escaping. Thus the solidity of the atom is variable, being of low degree in radio-active substances. Sir Ernest Rutherford has recently conducted a series of researches which are of much interest in relation to this subject. The results of his experiments with nitrogen indicate that this substance, which has always been considered an element, is in reality capable of a disintegration similar to that of radium.

The *alpha* radiations are extremely rapid and are possessed of enormous energy, which tends to disturb equilibrium. Sir Ernest Rutherford found by experiment that if one of these *alpha* radiations strikes the nucleus of a light atom, such as that of hydrogen, the latter is moved for a certain distance in the direction of the movement of the radiation. But when the *alpha* radiation comes in collision with an atom of nitrogen the effect is different—the radiation, which, as has been said, is very rapid and powerful, penetrates the atom before being reflected or repelled; certain particles are torn away and carried along in the direction of the radiation in the same way as were the atoms of hydrogen in the previous experiment. But the curious thing about this is that these particles appear to be atoms of hydrogen. Since the experiment was so conducted as entirely to prevent any access of hydrogen the conclusion seems inevitable that the hydrogen found has its origin in the nitrogen. To all appearance the *alpha* ray tears an atom of hydrogen away from the atom of nitrogen. Consequently Sir Ernest Rutherford suggests that the atom of nitrogen, whose atomic weight is 14, consists of a central nucleus composed of three atoms of helium (each having an atomic weight of 4), and of two atoms of hydrogen (whose atomic weight is 1). —*Bibliothèque Universelle.*

Machinery Recovered from the Germans

THE "Recuperation Service" and the "Restitution Service" of the French Ministry of Industrial Reconstitution in July made a report concerning the work of identifying and returning to France of French machinery that had been carried off and made use of by the Germans. Through the end of March the Restitution Service had shipped from Germany back to the departments in the north of France 1,085 tons; at the end of May the total had gone up to 18,511 tons; and since that date substantial shipments have been made from time to time. The shipments contained casks, glass, and a certain amount of industrial supplies in addition to machinery. There were also 200 carloads, with 2,265 tons of machinery, shipped from Germany to Alsace, and 2,980 tons found and identified in Belgium, shipped back to the original factories in the north of France. The total reshipped into the devastated regions of the north and into Alsace up to the end of May was over 21,000 tons. At that same date over 15,000 tons of identified machinery was being dismounted and loaded in Germany, and 20,000 tons more had been identified in the Grand Duchy of Luxemburg and in Germany, concerning which the representatives of the French Ministry of Industrial Reconstitution were awaiting instructions from the French manufacturers concerned.

Superior Work Tools Made from Aluminum Oxide

IF aluminum oxide (Al_2O_3) be vitrified at a temperature below its temperature of fusion, a product of great density and hardness is obtained possessing properties peculiarly favorable to the manufacture of many tools. This process is now employed for the production of "drawing-stones" for the purpose of the finest metal wire drawing. Roughly formed pieces of the material are first heated to from 1,300 to 1,400° C. and are then shaped and reheated to 2,000° C. The degree of hardness of this substance resembles that of sapphire and it exhibits uncommonly little sign of wear and tear after use.

NEW BOOKS, ETC.

AIRPLANE DESIGN AND CONSTRUCTION. By Ottorino Pomilio, Consulting Aeronautical Engineer. New York: McGraw-Hill Book Company, Inc., 1919. 8vo.; 403 pp.; illustrated.

In this transition period when the airplane, having made amazing advances in a war capacity, is being adapted to the traffic of peace, we cannot do better than accept as the basis of our new studies those European researches in aerodynamics to which practical progress in flight is so greatly indebted. This work presents in substantial detail the application of those researches to airplane design, and the data it gives should save our designers much time and expense. Structural features, operation, efficiency, and design are set forth in such a lucid and logical way that the book may also be used to advantage as a text in technical schools and colleges.

THE MAN WHO DISCOVERED HIMSELF. By Willis George Emerson. Chicago: Forbes and Company, 1919. 8vo.; 341 pp.; illustrated.

At the opening of this story the hero is fifty, a physical wreck and a social failure. A few years later he is a man of wealth, a successful lawyer, and the new governor of Arizona. The transformation is made plausible by a series of interesting adventures told in a matter-of-fact way, rich in the detail of desert and ranch life. It is a tale to arouse the fighting spirit and encourage to renewed endeavors those who have been buffeted by fate.

PRACTICAL DRY CLEANER, SCOURER AND GARMENT DYER. Edited by William T. Brannt and J. B. Gray. New York: Henry Carey Baird and Co., Inc., 1919. 12mo.; 378 pp.; 41 engravings.

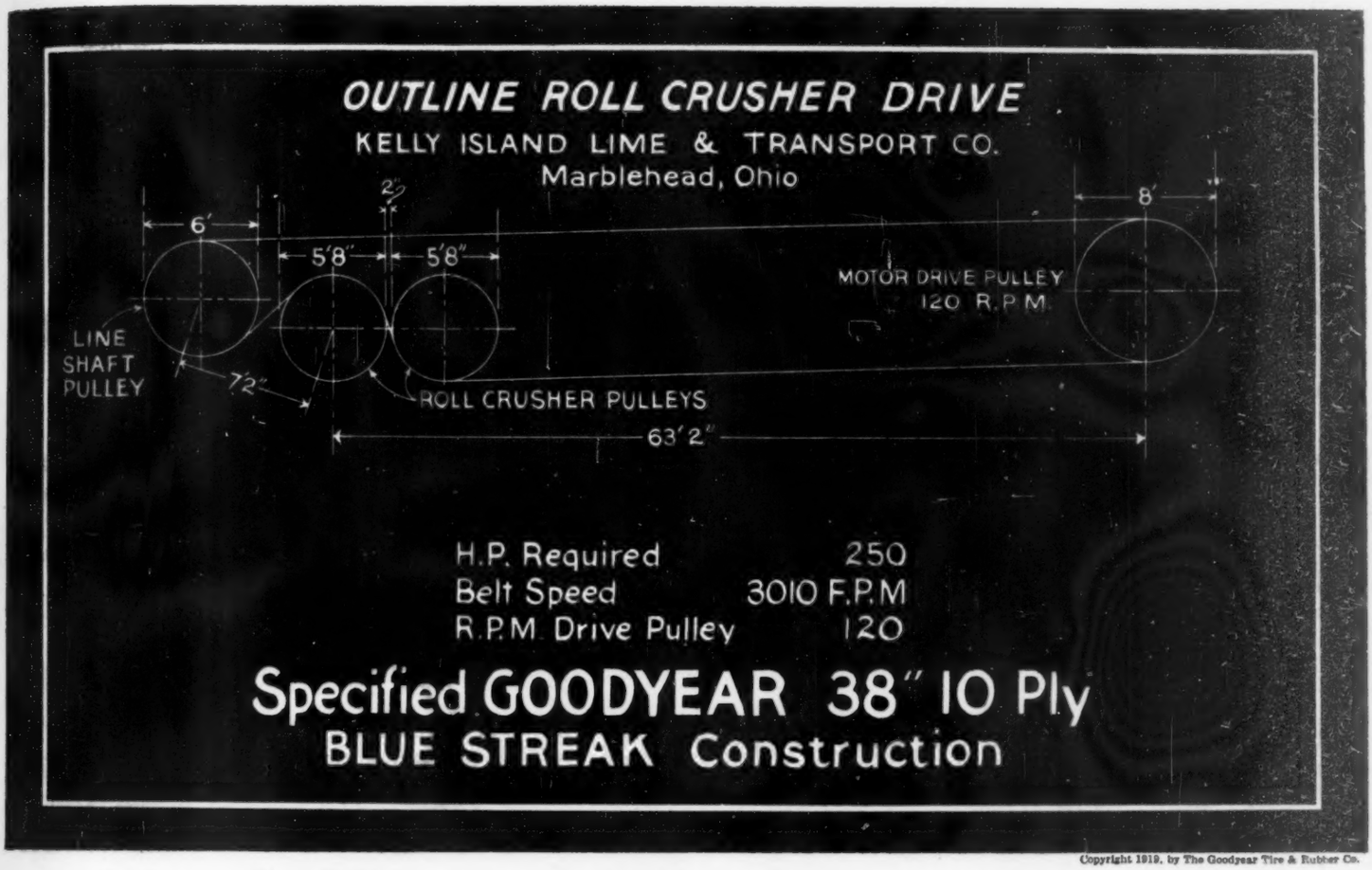
Cleaners, dyers and renovators may consult with confidence this fifth edition of a standard handbook written and re-written especially for their benefit. It covers the whole field in a concise yet adequate manner. Wet and dry cleaning, stain removal, the cleaning and dyeing of furs, skins, feathers, gloves and garments, and the renovation of hats, are set very plainly before the reader. It considers only American dyes, and tells how to use these to the best advantage. The engravings illustrate the tools and appurtenances of the trade, and the work is rounded out by a chapter on the analysis of textile fabrics, and another on practical chemistry.

MIRRORS, PRISMS AND LENSES. A Text-Book of Geometrical Optics. By James P. C. Southall. New York: The Macmillan Company, 1918. 8vo.; 580 pp.; illustrated.

This textbook is an introduction to the theory of modern optical instruments by a Columbia University professor who has made a specialty of geometrical optics. Mathematical processes are reduced to the simplest possible forms, and the author's experience with his own pupils has enabled him to present his subject in such a way as to come within the understanding of the beginner while containing much of interest to the better-informed reader. Spectacle optics, which has been a rapid development of late, is dealt with at some length, and the section on opthalmic lenses and prisms will appeal to the oculist and optometrist.

THREE YOUNG CRUSOES. By William Alphonso Murrill, A.M., Ph.D. Published by the Author, Bronxwood Park, New York City, 1918. 8vo.; 218 pp.; 83 halftones, 2 colored plates.

Shipwrecked on an island in the West Indies, two boys and a girl find their lives largely dependent upon their own resource and energy. They explore the island, irrigate and work a garden, have thrilling adventures, and make interesting discoveries. The story serves as a conveyance for natural history teachings, in which the many pictures and the colored plates take a prominent part.



Copyright 1919, by The Goodyear Tire & Rubber Co.

48 Months Versus 18 Months—and the G.T. M.

Up to four years ago the Edison roll-crusher drive shown in the blue print was considerable of a trouble maker as regards to belts. The tremendous burden of starting and turning the 15-ton rolls proved too great for the belts being used, their average life being about eighteen months. Then a Goodyear Belt was tried. It has already given nearly 48 months of service. Thus the Kelly Island Lime & Transport Company has already received from the Goodyear Belt 30 more months of service than from any belt used previously on this drive.

They have gained more than 30 months in service alone. When our Mr. Foster called four years ago he found that the belts then in use gave trouble. In damp weather they tightened so much that they endangered the bearings. In hot, dry weather they stretched so that frequently they had to be taken up several times a week in order to move the rolls at all. In addition, the grit and dust of the crusher used to chew up the belts and make them ragged and inefficient some months before they had to be discarded.

After careful study Mr. Foster recommended a Goodyear Belt of Blue Streak construction—absolutely waterproof, friction surfaced, unstitched, supple, and extraordinarily strong. The Kelly Island Company agreed to try it out.

The Goodyear Belt has never had to be taken up in its four years of hard work. The grit, dust, exposure and hard work have affected it so little that it looks good for two more years.

After the Goodyear Belt had been working for some months Mr. Foster called again. The Kelly Island Company were well pleased with the belt and interested in the construction which made possible the excellent service they were receiving. This Mr. Foster explained, adding that even that construction might be of little help if it didn't fit conditions. He pointed out how he had studied the drive, how he had specified for it a belt to fit the need, and had his recommendations checked by the Belting Engineering Department at Akron to be absolutely sure of proper application. A 10-ply belt seemed too heavy for the power, but it was certainly necessary to start the heavy 15-ton rolls.

Then he told them about the Goodyear Plan of Plant Analysis—of having a G. T. M.—Goodyear Technical Man—study every drive in a plant and specify the proper belt for it. They had a plant analysis made—not only in the Marblehead plant, but in all the plants of the company—and have since ordered many belts according to specifications of our engineers.

If you have a belt-eating drive, ask a G. T. M. to call. He will do so without charge when next he is in your vicinity. The G. T. M.'s services entail no obligation, because the savings they effect for belt users are so considerable that a gratifying volume of business is almost certain to result after a trial of his recommendations has been made.

BELTING · PACKING · HOSE · VALVES

GOODYEAR

MADE IN U.S.A.

COLGATE'S

Hints for Applying.

THERE is no need to rub Colgates lather in with the fingers. Don't do it—it only adds "mussiness" to what might be a genuine pleasure. Shave this way—and learn comfort.

With the Stick. After wetting the face pass the stick over the cheeks from ear to ear and back again, then under the chin; once across the upper lip. This gives soap enough for any but the heaviest beard. Work up the softening lather on the face with the wet brush—using hot or cold water.

With the Powder. First, wet the face with the brush. Separate the bristles slightly with the thumb and sprinkle about one-third of a thimble full of powder on the brush; you soon learn the exact amount you need. The lather is quickly worked up with hot or cold water—on the face.

With the Cream. If you prefer to apply the cream to the face always wet the face first, If you squeeze the cream on the wet brush. wet the face first. The plentiful fragrant lather is then worked upon the face with the brush—using hot or cold water according to preference.

Lather with Colgate's---then shave with comfort.

COLGATE & CO.
Est. 1806 New York